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# HYPODERMIC MEDICATION

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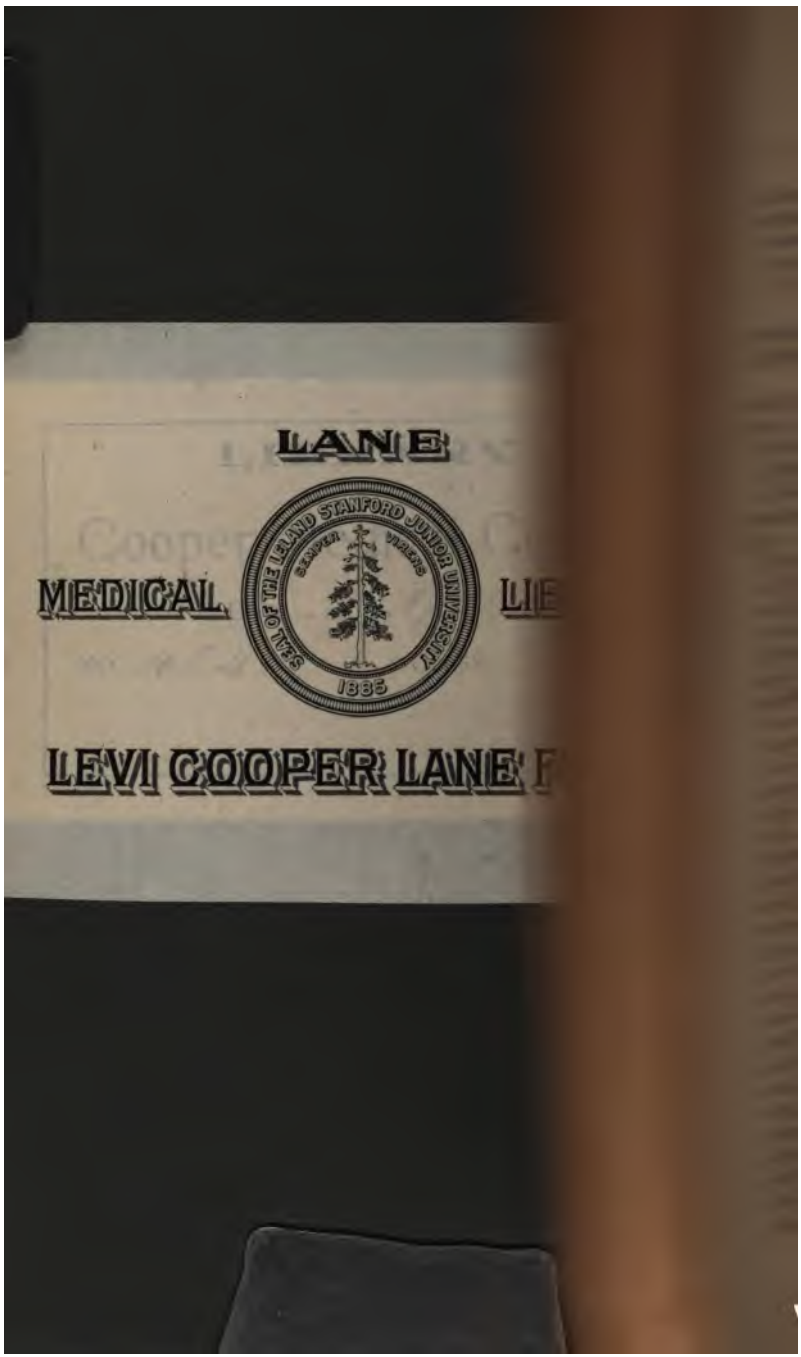
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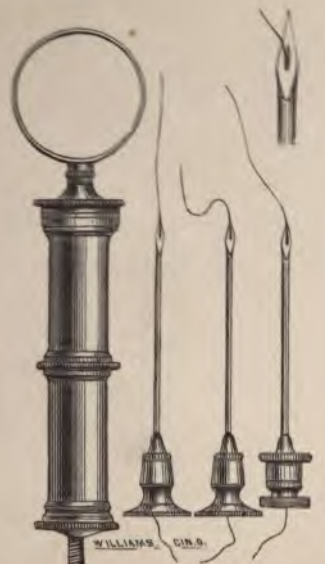


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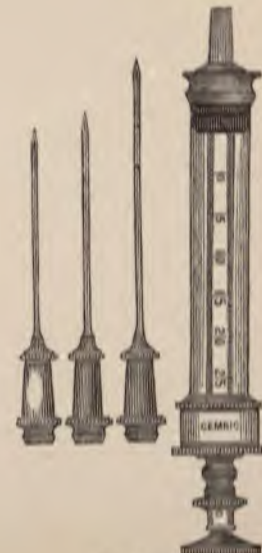


No. 3.

No. 1. Author's Silver Hypodermic Syringe. No. 2. Rimmers for cleaning Needles.
No. 3. Glass Hypodermic Syringe (Gemrig).

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B28
1879

Dedicated

TO

ANDREW HULL BAKER, A.M., PH.D.,

FORMERLY PRESIDENT OF CALVERT COLLEGE, MARYLAND,

BY HIS OBLIGED FRIEND

AND

FORMER PUPIL,

THE AUTHOR.

Je pense même, à raison de ces circonstances, que l'absorption sous-cutanée, qui n'a été employée jusqu'ici sur l'homme que par exception, devra devenir méthode générale pour l'administration de tous les médicaments énergiques, et à l'état de pureté.

Bernard.

Who that has suffered from a painful local affection can think of the alleviation of his sufferings which follows from the subcutaneous injections of an anodyne without gratitude?

Sir W. Jenner.

Die neueste Zeit, mehr und mehr einer nicht skeptischen aber rationell critischen Auffassung in therapeutischen Dingen zuneigend, hat diesen gewaltigen Apparat pharmaceutischer und dynamischer Mittel grossentheils über Bord geworfen, und beschränkt sich auf wenige, aber in eminenter Weise bewährte, locale Methoden. Dieser glückliche Uemschwung knüpft sich zum Theil an die Einführung der *hypodermatischen Injectionen*, welche die symptomatische Behandlung der Neuralgien ausserordentlich vereinfacht und vervollkommnet, die meisten älteren Verfahren ersetzt und überflüssig gemacht haben.

Eulenberg.

# PREFACE

## TO THE THIRD EDITION.

---

SEVERAL years having elapsed since the publication of the second edition of this manual, important alterations have been rendered necessary by the advance in knowledge. But few changes seem desirable in the first part, devoted to "History, Technology, and General Therapeutics," but many changes and numerous additions have been made in the second part, or "Special Therapeutics." Chapters have been added on the following topics: The Morphia Habit and its Treatment, Duboisia, Pilocarpine, Chloroform, Chloral Hydrate, Apomorphia, Aquapuncture; and all of the other chapters have had important additions made to them, and some of them have been entirely rewritten. The size of the volume has been considerably increased, and its usefulness enhanced, it is believed, by these alterations and additions.

As this is now the only work on the subject in the English language before the profession, and as this embodies the results of the most recent investigations, the author ventures to express the belief that it must continue to be useful to those for whom it was originally intended. The exhaustion of two editions and the demand for a third indicate that

the manual supplies an existing want. The author has, therefore, felt encouraged to increase the size and enlarge the scope of the manual, so as to make it still more worthy of the approval of the medical profession.

The hypodermic method has been greatly extended in range since it was first employed for the relief of pain. The applications of various agents by this mode to the treatment of different morbid states are even more important than the use of anodynes, and it is probable, as other active principles are discovered, the method will receive still greater extension. As, however, no good can exist in this world without a corresponding evil, the usefulness of the subcutaneous medication is embarrassed by a most serious abuse in the employment of the hypodermic syringe for the purpose of narcotic stimulation. It is no exaggeration to say that this abuse is becoming a gigantic evil, to the extent and dangers of which the medical profession should be fully alive. The author has set forth this subject, as amply as the limits of such a manual will permit, in a chapter on the morphia habit, and he begs now to add another warning in regard to the danger of the lengthened use of morphia subcutaneously; for no matter how much the original prescription may have been justified in the condition of the patient, and how conscientious the physician in his efforts to prevent abuse, if the habit be formed, the mental and moral degradation which ensues will always be referred to as the blunder or the crime of Dr. So-and-so.

R. B.

1509 WALNUT STREET,
PHILADELPHIA.

# PREFACE

## TO THE SECOND EDITION.

THIS edition is not a mere reprint of the first. Numerous and important additions have been made in various parts of the work. I have sought to incorporate every real improvement in hypodermic medication which has been announced since the appearance of the first edition. Much has been proposed that does not appear to me to be of permanent value, and hence I have omitted it, in conformity with my original design of keeping on the strictly practical side of my subject. Whilst I have omitted much that seemed wanting in the essential quality of utility, I have not felt at liberty to reject from consideration any remedy a knowledge of whose uses might aid the physician in an emergency.

Now that the first enthusiasm which attended the introduction of this method has died away, we are in a position to estimate accurately its true merit. It is gratifying to me to observe that the judgments pronounced in the first edition, in regard to the various agents employed in this way, have been confirmed by a larger personal experience and by the general voice of the medical profession. The hypodermic method is, certainly, a very important

addition to our resources, and no physician can be considered as doing justice to his *clientèle* who does not give them the advantage, in suitable cases, of its great curative value.

In conclusion, I have to express my obligations to the reviewers for their very favorable notices of the first edition, and to the medical profession for the estimate which they have placed on my labors.

R. B.

27 West 8th Street,
Cincinnati.

# PREFACE

## TO THE FIRST EDITION.

As a teacher of Therapeutics, and as a practitioner, it has frequently been brought to my notice that the information existing in our language on the subject of hypodermic medication is exceedingly meagre. I have been urged by students and practitioners to prepare a convenient manual, to embody in small compass what is really known of value on this subject. This little work is the result.

Those who do me the honor to read my book will find that I have drawn largely upon my personal experience in the use of the hypodermic method. This fact, together with the necessity I was under not to enlarge my work beyond the boundaries of a "manual," will, I trust, excuse the apparent dogmatism of my statements. As, however, the experience and observation of one individual, how great soever may have been his opportunities, must necessarily, in so extensive and important a subject, be incomplete, I have not neglected the contributions of English, French, and German physicians to this department of practical medicine.

I am indebted to the present resident physicians of the Good Samaritan Hospital for important aid. Drs. De

Courcey and Rutter, with a scientific zeal which does them honor, submitted themselves to experiments in order to elucidate some important points in the physiological action of morphia and atropia. Dr. Galbraith made and recorded the observations.

Dr. J. S. Unzicker, of this city, a very capable physician and pharmaceutist, has placed me under obligations for numerous careful experiments, to determine what agent, if any, is best suited to prevent change in solutions prepared for hypodermic use.

R. B.

CINCINNATI, OHIO.

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# MANUAL

OF

# HYPODERMIC MEDICATION.

## PART I.

**History, Technology, and General Therapeutics.**

### I.

#### HISTORY.

THERE are two important epochs in the history of hypodermic medication:

1. The discovery of the practicability and utility of introducing medicines under the skin for the relief of local pain.

2. The subsequent demonstration that the physiological and therapeutical effect of medicines thus administered are procured through the agency of the blood, and that "localization" of the injection is not necessary.

We are indebted for the first discovery to Dr. Alexander Wood, of Edinburgh, and for the second to Mr. Charles Hunter, of London.

Dr. Wood ascertained, in 1843, that a solution of

morphia injected under the skin, in the vicinity of a painful part, afforded remarkable relief to the pain. His first publication on the subject was made in 1855, in the "Edinburgh Medical and Surgical Journal." The prior claims of Dr. Wood have been disputed by Mr. Rynd, of Dublin, for himself, and by Dr. Sieveking, of London, for Kurzak, of Vienna.* Mr. Rynd affirms that "the subcutaneous injection of medicinal substances, to combat neuralgia, was first used by himself in Meath Hospital, in 1844." It appears, however, that Dr. Wood's method was known and practised in Edinburgh as early as 1843. Dr. Sieveking asserts that "Dr. Kurzak, of Vienna, was the first to employ the subcutaneous or hypodermic method, which was then largely used by Dr. Wood, of Edinburgh." If this statement be correct, it is not a little remarkable that the German writers on this subject do not advance the claims of Dr. Kurzak to priority of discovery. I am unable to find in the works of Erlenmeyer,† Lorent,‡ and Eulenberg,§ any mention of Kurzak's claims; on the contrary, these authorities award to Dr. Wood the honorable

---

* Lancet, 1861, vol. i. p. 309.

† Die subcutanen Injectionen der Arzneimittel, von Dr. A. Erlenmeyer. Neuwied und Leipzig, 1866. Dritte Auflage, p. 1.

‡ Die hypodermatischen Injectionen nach clinischen Erfahrungen, von Dr. E. Lorent, in Bremen. Leipzig, 1865; p. 1.

§ Die hypodermatische Injection der Arzneimittel, etc., von Dr. Albert Eulenberg. Berlin, 1867, p. 10.

distinction of being the author of the hypodermic method.

Although the remote or systemic effects produced by subcutaneous injections were observed by Dr. Wood, he nevertheless attributed the curative power to the local action of the substance injected. "The local effect depends," he informs us, "much upon the affinity between the particular medicine administered and the tissue to which it is applied." In accordance with this view of the *modus operandi*, he directs that "the instrument is not to be put into the place where the patient complains of pain, but into the spot where you find you can awaken the pain on pressure,"—the painful points of Valleix. That Dr. Wood was not unobservant of the remote or systemic effect of subcutaneous injections is evident in the following remarks:

"It is truly astonishing how rapidly it affects the system. If you throw in a large quantity (of morphia), you will see the eyes immediately injected and the patient narcotized, and in a few minutes afterward you will see him in a profound sleep."

It was reserved for Mr. Charles Hunter to demonstrate the important fact that the application of the injection to the painful points, as contended for by Wood, was really unnecessary, and that equally good effects followed the introduction of the injection into a distant part. Mr. Hunter's first paper appeared in 1859, and was entitled "Experiments relative to the Hypodermic Treatment of Disease." These experi-

ments, made on animals, demonstrated that hypodermic injections "acted by absorption; that they acted quicker than by the endermic method, or than stomachic doses; that they acted more effectually; and that a small injected dose was equivalent to a much larger one by the stomach." Mr. Hunter was permitted to use the method of Wood on two patients afflicted with neuralgia, in care of Dr. Pittman in St. George's Hospital. As "both had abscess in the neuralgic site, from the continuance of the localization," the point of introduction of the injection was varied, and it was found—"First, that in neuralgia equal benefit followed distant injection of the cellular tissue as followed the injection of the neuralgic site; secondly, that localization was not necessary to benefit a given part; and thirdly, that for certain reasons it was better not to localize—the chief being: 1, The infliction of unnecessary pain; 2, the almost certain risk of irritating, thickening, or inducing matter in the part from repetition; and 3, it became evident that a large class of neuralgia would be excluded from this treatment if it was necessary to inject the neuralgic site."

Great praise must be awarded Mr. Hunter for his success in demonstrating these important conclusions, and for popularizing his method. His industry in collecting facts and presenting them to the profession was indefatigable. His views were perseveringly advanced,—not always in very correct or elegant English, as the reader will observe,—but with an

intelligent appreciation of the nature and importance of his facts. He read papers before societies; he published articles in the "Medical Mirror," "Lancet," "Medical Times and Gazette," and "British and Foreign Medico-Chirurgical Review;" he issued a pamphlet* containing all of his previous papers and some additional facts, and he enlisted, by personal effort, many of the physicians and surgeons of London in a trial of the new therapeutical expedient.

It was thus, chiefly through the efforts of Mr. Hunter, that the method of Wood, previously confined to Edinburgh and to Dublin, became naturalized in England. Mr. Hunter's papers in the "Medical Times and Gazette" attracted the attention of Courty, of Montpellier, and Béhier, of Paris, who popularized the new method in France. It was soon after tried and reported upon favorably by Scanzoni, of Wurtzburg; Oppolzer, of Vienna; Graefe, of Berlin, and numerous other eminent authorities on the Continent. In 1865 a small treatise, by Dr. Lorent, of Bremen, appeared at Leipsic. A monograph, by Dr. Erlenmeyer, passed to the third edition in 1866. In 1867 the second edition of the elaborate work of Dr. Albert Eulenberg was published in Berlin. Dr. Eulenberg gives a list of two hundred and twenty articles and essays in various languages, but chiefly

* On the Speedy Relief of Pain and other Nervous Affections by means of the Hypodermic Method. Churchill, London, 1865.

in German, which appeared on this subject from 1855 to the date of publication of the second edition of his work. From these facts may be seen the extraordinary extension which has been given to this method of treatment on the Continent.

The method of Wood, as illustrated by Hunter, met with a more favorable reception on the Continent than in the country of its origin. According to Dr. Anstie,* "it is still very much unappreciated" in England. It is true that the principal English physicians and surgeons think highly of the method, and now employ it largely, but, as Dr. Anstie informs us, there are "practitioners who will not admit that there *can* be any particular advantage in it which the old way of giving medicines does not offer."

The hypodermic method, soon after its publication by Wood, was introduced into the United States. Dr. Fordyce Barker, of New York, whilst in Edinburgh in 1856, was presented by Prof. Simpson with a hypodermic syringe. Soon after his return home, in May, 1856, he used this instrument, and was, consequently, the first in this country to practise the method of Wood. Prof. Barker's syringe was the model from which Tieman's instruments were made. In August, 1857, the late Prof. George T. Elliot published some observations on the hypodermic method. It thus appears that the new mode of using medicines was known and employed in New York

* The Practitioner, July, 1868.

when Dr. Ruppaner's articles appeared in 1860 in the "Boston Medical and Surgical Journal."

Not only was the hypodermic method as taught by Wood early naturalized in the United States, but we have data for asserting that it was practised in New York before Wood made public his discovery, or before the earliest date assigned by Mr. Rynd, of Dublin, for his use in this way of remedial agents. Dr. Isaac E. Taylor, in a communication to the "New York Medical Gazette"* shows that Dr. Washington and he used practically the same method in the New York City Dispensary so long ago as 1839. The idea was suggested to them by the results of Lafargue's method of inoculation. Instead, however, of inserting the solid medicament by means of a grooved needle, as was Lafargue's practice, these gentlemen punctured the skin with a lancet, and by means of an Anel's syringe threw a solution of the medicine under the skin. This mode of operating was the same practically as that suggested and used by Wood in 1855.

When the first edition of this work was published (1869), I was not then aware of the above facts in regard to the introduction of the hypodermic method in this country. It affords me sincere pleasure to attribute to my own countrymen the credit to which they are justly entitled.

---

* April 23, 1870.

## II.

### TECHNOLOGY.

Mr. Hunter proposed the term *hypodermic* in 1859, to make the terminology uniform with that already in use. The word is compounded of two Greek words, ὑπο, *under*, and δερμα, *the true skin*. In accordance with the rules of construction, the term "hypodermatic" should be used, rather than "hypodermic," but the latter is now so firmly established in ordinary usage that it were probably better to retain it than to substitute a new term. By this method, then, the medicine is introduced not *into*, but *under*, the true skin, into the subcutaneous areolar tissue. This does not include the method of inoculation as practised by Lafargue, nor the injection of irritants into diseased tissues, as proposed by Luton* and further illustrated by Bertin.† The method of Luton has, however, sufficiently close relationship with the hypodermic method, and possesses of itself sufficient value, to justify me devoting a short chapter to it.

The subcutaneous method proper consists in:

1st. The medicine in a state of solution.

2d. An instrument for injecting the solution into the subcutaneous areolar tissue.

---

* Archives Générales de Médecine, Oct. 1863.

† Ibid., Avril, 1868, p. 444.

THE SOLUTION.—A medicine employed for hypodermic use should be capable of perfect solution in the vehicle, which is usually distilled water. Particles of medicine undissolved are not only not in a condition to be readily absorbed, but act as irritants to the tissue, producing inflammation and abscess.

The solution should be free from dirt or foreign matter of any description.

The solution should be neutral, or, at least, without decided acid or alkaline property.

Any substance which will coagulate the blood, or produce violent irritation, is unfit for hypodermic use.

A solution, even of a neutral substance, should not be too concentrated. Pure distilled water is entirely harmless, and the quantity of fluid injected is, within certain limits, a matter of indifference, provided suitable care be used in selecting the site and in injecting. Concentrated solutions, *cæteris paribus*, are more apt to produce local irritation than dilute solutions. Moreover, if the solution of a powerful alkaloid be very concentrated, a drop too much injected may produce dangerous symptoms. In ordinary syringes, a few drops remain at the bottom of the cylinder and in the needle; hence it is difficult, in using a very concentrated solution, to inject the precise amount desired, or, indeed, to approximate to it very closely.

Solutions of alkaloids too long kept become unfit for hypodermic use, by reason of the development in them of a *penicillum*. This organism grows at the expense of the alkaloid, and hence the solutions di-

minish in strength as the parasite develops. I have tested the utility of the various agents which may be employed to prevent the development of this penicillum, but have not arrived at a satisfactory result. Carbolic acid, alcohol, alum, and acetic acid, unless added to the solution in quantity sufficient to prove irritant, have not succeeded, after a sufficiently prolonged trial. The mineral acids are effective, but they confer such irritant properties on the solution as to render its use very painful, as well as injurious. The proper method is to prepare fresh solutions as often as may be necessary, and in such quantities as the exigencies of practice may require.

In consequence of the difficulty experienced in keeping without change a solution of morphia, I now prepare it at the time of administration by dissolving a powder of definite strength in clean water. This plan will answer with morphia and a combination of morphia and atropia, but is impracticable with atropia, strychnia, ergotin, and some other agents.

I cannot too strongly urge upon the practitioner the expediency of preparing the solutions himself. The *material* required is not expensive, the processes are simple, and the confidence which comes of personal knowledge of the accuracy in the proportions is of advantage in handling the remedy. The apparatus required for this purpose consists of the following articles:

A fine grain druggist's balance.

A small glass or wedgwood mortar.

A small glass funnel.

Fine Swedish filtering paper.

Pure distilled water.

The medicine, solution of which is to be made, is to be finely triturated in the mortar, and the distilled water gradually added, with continuous stirring. When the solution is made, or before being used, it should be passed through the filter. Before the filter is used for purifying the solution, distilled water should be passed through it, to carry off loose particles of paper and dirt which may have collected in the funnel. When prepared, the solution should be preserved in carefully stoppered vials. Stoppers of cork are unsuitable, owing to the friable nature of that material.

The practitioner should provide himself with ounce vials, having ground-glass stoppers, for containing the solutions ordinarily in use. They should be carefully labelled with name of alkaloid, the quantity to the ounce, and the proper dose.

THE INSTRUMENT.—The instrument for introducing the solution under the skin consists of a syringe, the nozzle of which is a perforated needle. The syringes first employed were crude instruments. Not being provided with a needle point, a preliminary incision through the skin was necessary in order to introduce the canula. (Instrument of Wood, and the Pravaz syringe.) Mr. Rynd, of Dublin, invented a complicated apparatus for introducing the solution

under the skin, the fluid flowing out by the force of gravity. Mr. Hunter's syringe is thus described by himself: "The barrel is of glass with silver fittings, and contains a piston which works by a screw-rod, each half turn of which expels half a minim as a fine drop at the end of the pipe. Two pipes belong to each syringe, the one larger and stronger than the other. . . . The smaller pipe will be found the best for general use; it screws on and off the barrel at pleasure, and is made of silver with a hardened gold point. The point is sharp like a needle, and perforated on one side by an oblique opening."

The syringe of Pravaz, as modified by Béhier, is much used in France. This is very similar in construction to Mr. Hunter's; it is of glass; the piston works with a screw, and the needle is attached by a screw to the barrel. The syringe of Mathieu, known as the "decimal hypodermic syringe," and graduated according to the French metrical system, is also a modification of that of Pravaz. The instrument of Luer, which is most popular in Germany (Eulenberg), is graduated on the flat side of the semi-cylindrical piston-rod, and has a set screw, which can be used or not. The needle fits accurately by a socket-joint, without being screwed on, and has a lancet-shaped point, slightly concave on its perforated side to facilitate transfixing the skin. The Committee on Hypodermic Medication of the Medico-Chirurgical Society* recommended Coxeter's, Whicker and

* Medico-Chirurgical Transactions, vol. l. p. 564.

Blaise's, and Weiss's syringes. I am familiar with the instrument of Weiss only. This has a glass cylinder, screw-piston, is graduated, and has a capacity of thirty minims. Dr. Anstie thinks "the ideal syringe, perhaps, is a Coxeter, with the addition of a screw-joint, by which the barrel can be removed and refilled without withdrawing the canula from the skin."

In this country a modification of the Pravaz instrument, imported from France, is found in the shops. It has a glass barrel, graduated, and having a capacity of thirty minims. The piston works, with or without a screw, by means of an auxiliary screw attached, not to the mountings, but to the piston itself. It contains two gold-plated needles, differing in size, and they fit to the barrel accurately by a socket-joint, and do not screw on. Although any of these instruments may perform, more or less satisfactorily, the work required of them, they do not equal, in the judgment of the author, the instrument to be presently described. There are two strong objections to an instrument of glass:

The mountings work loose and readily give way, unless connected by lateral supports, as in the Charrière syringe.

The glass cylinder breaks easily, especially if graduated.

The advantages of a glass instrument are these:

The cylinder may be graduated.

The contents are visible to the eye.

Excellent glass instruments are now made. The cylinder is encased with metal, except the graduated part. The mountings of the cylinder, being connected with the metal, do not work loose and give way. Of course, even in these instruments fracture of the glass cylinder may readily occur.

Cheap instruments of hard rubber are also in use. They quickly get out of order, and are much inferior in construction to the fine English, French, and German syringes mentioned above. Nevertheless, a hard rubber syringe may be preferred for the injection of certain minerals.

After considerable experience and no little vexation in the use of various kinds of instruments, I do not hesitate to declare my preference for the silver hypodermic syringe. It is made of pure silver, and has a capacity of thirty minims. It contains two gold needles of different sizes, and also a trocar, which screw on to the barrel. The needles are somewhat lancet-shaped, and readily perforate the skin. The piston does not work with a screw; it is packed with leather, and accurately fits the barrel. The lower extremity of the piston is filled in with a silver plate, which closely adapts itself to the bottom of the cylinder, in order to insure the expulsion of all the fluid. The piston-rod may be graduated, but I prefer to use a minim-glass. The piston of this instrument works so accurately that every drop in the minim-glass may be drawn up into the barrel by aspiration, and all may be

injected except the small portion which remains in the needle.

The advantages of the silver hypodermic syringe are these:

It is not readily broken.

It will wear indefinitely.

It performs the required work in a satisfactory manner.

Nothing is more certain, however, than that carelessness will render useless the best instrument. Some details, therefore, with regard to the care of a hypodermic syringe will not be considered superfluous.

The leather packing must be kept well oiled, and so spread out that when the piston is forced down, the orifice of exit being closed, air cannot pass the piston. If the leather be permitted to become dry and shrink, the instrument will be unfit for use, and possibly at a time when its use might be urgently demanded. The cylinder should be frequently washed out with pure water, to insure that it is free from undissolved medicine and particles of dirt. The needles must be wiped dry after use, and the fine wire with which they are accompanied must be introduced. If long disused, the needles rust and become closed. There should accompany each hypodermic syringe a *rimmer*, an instrument for cleaning out the needles when obstructed.

A capital expedient for keeping the piston moist and free from filth is a screw-cap which screws on after the needle is removed. A little water should be

permitted to remain in the barrel of the instrument, and the cap then screwed on. When it is used again, the water should be discharged through the needle. This serves to remove from the needle any adherent particles.

Undoubtedly the utmost circumspection is necessary in the use of the needles,—for diseased blood, or specific virus, may be transmitted from one person to another. Beside the cleanliness enjoined, the practitioner must see to it that needles used in infected persons must not be again employed in those free from infection.

There are several methods by which the hypodermic syringe may be charged with the required dose of the solution. The fluid may be drawn up into the barrel by aspiration, or the cap of the barrel may be unscrewed, the piston removed, and the solution poured into the barrel. The former is more convenient. If air enter when the fluid is being drawn up, it may be readily expelled by inverting the barrel and moving up the piston until a drop of the fluid presents itself at the orifice of the needle. In using a glass instrument which is graduated, more of the solution should be drawn into the barrel than it is contemplated to administer, and, fixing the eye upon those divisions of the scale representing the amount to be injected, the piston is made to traverse slowly the proper space. In filling my silver instrument I pursue the following method: I pour into a minim-glass the proper quantity of the solution. The needle being screwed

into its place, I insert the point into the solution and draw the whole amount into the barrel of the syringe by slowly elevating the piston, inclining to one side the minim-glass, in order to take up the last drop. If air have entered, I invert the syringe and push up the piston slowly until it is all expelled. An allowance of one minim should be made for loss.

The mode of injecting, which is very simple, is as follows:

Take up between the thumb and forefinger of the left hand a loose fold of skin in some convenient situation. Push in the needle with a quick and decided motion, at a right angle to the direction of the fold. The resistance ceasing, it will be known that the needle has perforated the skin, and the point of the needle may also now be freely moved about in the subcutaneous areolar tissue. It is better to pass the needle for an inch or more under the skin, to have sufficient space for the fluid. The injection must be made slowly, drop by drop, so that the fluid may diffuse itself without rupturing any small vessels, or the fibres of the connective tissue. When all has been injected, withdraw the needle slowly, pressing at the same time upon the puncture to prevent escape of the fluid. A few minutes' pressure will suffice to retain the fluid, and to arrest the little bleeding which sometimes takes place. A bit of isinglass plaster may also be applied to the puncture, but this is generally unnecessary. By some persons the fluid is always injected into a muscle; and this is the

method of using strychnia in paralysis, but is not frequently adopted for other agents employed hypodermically. To inject into a muscle, for example the brachialis anticus, make it tense by flexing the forearm, and then by a quick motion thrust the needle directly into the muscle. It is claimed for this method that it is less painful and less liable to be followed by abscess than by the injection under the skin, but it is obviously improper if any considerable amount of fluid is to be injected.

In practising the hypodermic injection, it is important to avoid puncturing a vein. Serious depression of the powers of life, fainting, and sudden and profound narcotism have been produced by injecting a solution of morphia directly into a vein. Fatal collapse might be induced by injecting air into a large vein along with the solution.

Bony prominences should also be avoided, for in these situations the skin is not sufficiently loose to permit the ready entrance of the fluid, and inflammation and abscess will follow a too forcible injection.

The puncture should not be made, as a rule, into inflamed parts. I have known a bad phlegmon produced by injection into the tissues of an inflamed wrist.

It is not necessary to follow the original method of Wood, and inject into those points in which pain can be awakened by pressure. Some exceptions to this rule undoubtedly exist, as will hereafter be shown, but they are not numerous. The arm, the

outer face of the thighs, the calves, the abdomen, and the back are suitable places for the injection. The arm, about the insertion of the deltoid, is generally selected. Eulenberg makes the assertion that the effect is slower when the injection is made in the back than in any other situation.* I have not been able to observe any difference in the rapidity of effect as influenced by the site of the puncture. If, as sometimes happens, the patient prefer injection into the painful part, it will be well to yield to his prejudices, provided no contraindication exist thereto.

If the patient be timid and intolerant of pain, the sensibility of the skin may be lowered by ether or rhigolene spray. A piece of cotton cloth moistened with chloroform and held on the skin a few minutes is nearly as effective as the douche, and much more convenient. Sometimes redness and swelling take place at the site of the injection. This is best relieved by a cold wet compress.

The syringe, half-ounce glass-stoppered vials containing the solutions most frequently used, and minim-glass, should be contained in a small leather pocket-case, at all times ready for use.

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* Die hypodermatische Injection, etc., op. cit., p. 62.

## III.

### GENERAL THERAPEUTICS.

A REMEDY administered by the stomach is affected in its physiological and therapeutical action by the condition of that organ. Disease, as for example gastric catarrh, limits, if it may not entirely prevent, the absorptive action of the mucous membrane. Also, the state of repletion of the veins, the presence of other ingesta, and the condition of annexed organs influence the rate and extent of absorption. The digestive fluid undoubtedly exerts a chemical action upon many remedial agents, thereby retarding, limiting, or preventing their physiological and therapeutical activity. Lastly, many agents, of the narcotic class especially, depress the nerves of the stomach, and in this way affect the rate and degree of absorption. On the other hand, when a medicine suitable for the purpose is thrown under the skin, its physiological and therapeutical effects are produced in the fullest degree and in the most characteristic form. It follows, then, that the therapeutical powers of a drug must not only differ in degree, but also in kind, according as it is given by the stomach or injected under the skin. Experience and observation demonstrate the truth of this statement. The subcutaneous use of certain drugs has developed very valuable therapeutical properties, which the stomachic admin-

istration had not even suggested. Bernard* affirms that this mode of administering remedies, which has hitherto been the exception, must become the general method for the use of active principles. The advantages of this method over other methods, considered from the point of view of practical therapeutics, are manifold.

The effect is produced more speedily, and the whole effect of the quantity introduced.

The results are more permanent and curative.

Gastric disturbance rarely occurs, and irritation of the stomach is avoided.

The administration may be made to persons unwilling or unable to swallow.

It follows, then, that remedies suitable for this purpose may be used hypodermically, to produce—

1st. All of the physiological and therapeutical effects which can be accomplished by them when given by the stomach; and

2d. The physiological and therapeutical effects peculiar to this method.

The hypodermic method may be employed for—

1st. A local action only.

2d. The general or systemic effects.

LOCAL EFFECTS.

To cure nævi, aneurisms, varicose veins, etc., by coagulating the blood (liq. ferri subsulphatis; liq. ferri perchloridi, etc.).

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* Archives Générales, 1864.

To destroy morbid growths, goitre; or irritant injections into substance of tumors (tinct. iodinii iod.; acetic acid in cancer, etc.).

REMOTE OR SYSTEMIC EFFECTS.

| | |
|---|---|
| As a cerebral sedative..... | In Insomnia.<br>Melancholia.<br>Mania.<br>Puerperal mania.<br>Delirium tremens, etc. |
| As a moderator of reflex action..... | In Epilepsy.<br>Chorea.<br>Eclampsia.<br>Hysteria.<br>Tetanus.<br>Hydrophobia, etc. |
| As a motor excitant..... | In Paralysis, etc. |
| As an anodyne ..... | In the various forms of neuralgia, etc. |
| In affections of thoracic viscera ..... | Spasmodic Cough.<br>Whooping-cough.<br>Asthma.<br>Angina pectoris.<br>Bronchitis.<br>Pleuritis.<br>Pericarditis, etc. |
| In affections of digestive system..... | Dyspepsia.<br>Vomiting of pregnancy.<br>Sea-sickness.<br>Cholera morbus.<br>Colic.<br>Intussusception.<br>Enteritis.<br>Peritonitis.<br>Hepatic colic.<br>Scirrhus, etc. |

| | |
|---|---|
| In affections of the genito-urinary apparatus..... | Dysmenorrhœa.<br>Uterine colic.<br>Nephritic colic.<br>Spasmodic stricture.<br>Spasm of sphincter vesicæ.<br>Spermatorrhœa.<br>Chordee, etc. |
| In fevers..... | Periodical fevers, etc. |
| In blood diseases..... | Rheumatism.<br>Syphilis, etc. |
| As an antidote..... | Opium.<br>Belladonna.<br>Strychnia.<br>Physostigma, etc. |

To produce the effects embraced in the above tabular statement, a number of remedial agents have been employed by the hypodermic method. As I have already indicated in my remarks on solutions, drugs in a crude state are not in a sufficiently active and soluble form for this mode of administration; hence the active principles are chiefly used.

The following agents have been employed hypodermically:

| *Source.* | *Preparation for Subcutaneous Use.* |
|---|---|
| Opium.<br>(Papaver Somnif.) | Tincture; Acetated Tincture.<br>Extract; Liq. Opii Comp. (Ruppaner.)<br>Morphia and its salts.<br>Narceia.<br>Codeia.<br>Narcotina.<br>Thebaina.<br>Apomorphia. |

| | |
|---|---|
| Belladonna. (Atropa Belladonna.) | Atropia and its salts. |
| Duboisia. (Duboisia Myoporoides.) | Duboisine and its salts. |
| Hyoscyamus. (Hyoscyamus Niger.) | Hyoscyamia and its salts. |
| Stramonium. (Datura Stramonium.) | Daturia and its salts. |
| Coffee. (Caffea Arabica.) | Caffein and its salts. |
| Tobacco. (Nicotiana Tabacum.) | Nicotia and its salts. |
| Aconite. (Aconitum Napellus.) | Aconitia and its salts. |
| Conium. (Conium Maculatum.) | Conia and its salts. |
| Colchicum. (Colchicum Autumnale.) | Colchicia and its salts. |
| Nux Vomica. (Strychnos Nux Vomica.) | Strychnia and its salts. |
| Woorara. | |
| Digitalis. (Digitalis Purpurea.) | Digitalina. |
| Veratrum. (Veratrum Album.) | Veratria. |
| Ergot. (Secale Cornutum.) | Ergotina. Ergotin. |
| Calabar Bean. (Physostigma Venenosum.) | Extract; Eserine. |
| Hydrocyanic Acid. | |
| Cinchonia. | Quinia and its salts. |
| Ipecacuanha. (Cephaëlis Ipecac.) | Emetia. |

| | |
|---|---|
| Iodine. | Tincture; Iodide of Potassium. |
| Sodium. | Chloride. |
| Ammonium. | Chloride. |
| Iron. | Liq. Ferri Subsulphatis. |
| Copper. | Sulphate. |
| Chloral. | |
| Chloroform. | |
| Silver. | Nitrate. |
| Mercury. | Corrosive Sublimate. Biniodide. |
| Arsenic. | Liq. Sodæ Arseniatis. |

Many of these agents have either proved unsuitable for subcutaneous injection or are inefficient. In the following pages I propose to consider those the utility of which has been established by experiment and clinical observation. They are the following:

**Morphia and its salts.**
**Apomorphia.**
**Atropia and its salts.**
**Duboisia and its salts.**
**Strychnia and its salts.**
**Conia and its salts.**
**Woorara.**
**Eserine and its salts.**
**Pilocarpine and its salts.**
**Caffea and its salts.**
**Nicotia and its salts.**
**Hydrocyanic acid.**
**Chloroform.**
**Chloral hydrate.**
**Quinia and its salts.**
**Ergotin.**

Carbolic acid.
Iodide of potassium; tincture of iodine.
Mercury.
Subsulphate and perchloride of iron.
Arseniate of soda; Fowler's solution.

In practice it will be found that this list may be much reduced. For the ordinary contingencies of medical practice, the following only are necessary:

Morphia (sulphate).
Apomorphia.
Atropia (sulphate).
Eserine (sulphate or muriate).
Strychnia (sulphate).
Pilocarpine (nitrate).
Quinia (sulphate).
Chloroform.
Ergotin.

# PART II.

## Special Therapeutics.

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### I.

### MORPHIA.

THE SOLUTION.—There is no general agreement as to the salt of morphia best adapted to hypodermic use. As the sulphate is the most soluble salt, this should be preferred. In Germany the hydrochlorate is much used. The formula of Eulenberg* is as follows:

℞.—Morphiæ hydrochlorat., gr. iv;
Acidi hydrochlor., gutt. iv;
Aquæ destil., ʒi. M.

In this formula the muriatic acid serves a double purpose: it increases the solubility of the morphia, and it prevents the development of the *penicillum*. But acid solutions, as I have already pointed out, increase the pain and smarting which attend the injection, and not unfrequently produce inflammation and abscess. The Committee of the Medico-Chirur-

* Op. cit.

gical Society, in their experiments, used the acetate of morphia dissolved by the aid of sufficient acetic acid, and afterward neutralized with liquor potassæ. The Committee wisely remark: "In using drugs which require an acid to render them soluble in water, it was found that very acid solutions were apt to irritate, and the solutions were therefore carefully neutralized." Would it not have been better to use a salt of morphia readily soluble in water without the aid of an acid, the more especially as the Committee had ascertained that pure water occasioned very little irritation?

Dr. Anstie, in a very valuable paper on "The Hypodermic Injection of Remedies,"* says that "morphia should be used in the form of acetate dissolved with a minimum of acetic acid in hot distilled water, five grains to the drachm." This solution, it appears to the writer, is objectionable in several respects. It is too concentrated, one minim containing one-twelfth of a grain, a quantity difficult to inject with accuracy by an ordinary syringe. Dr. Anstie himself states another objection: "As the salt varies in solubility, it will often happen that, on cooling, the solution will solidify. This is not of much consequence, as it can be heated in hot water at the moment of use."

I prefer a simple solution of the sulphate, according to the following formula:

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* The Practitioner, July, 1868.

℞.—Morphiæ sulphat., gr. xvi;
Aquæ destil., ʒi. M.
Dissolve and filter.

The morphia should be rubbed up in a mortar and the distilled water added gradually. A perfect solution will be obtained, which does not require an acid. Fifteen minims represent half a grain; five minims a sixth of a grain.

Dr. Wilson,* after an elaborate review of the subject, concludes "that the solvent for morphia should be distilled water without any admixture of acid."

A solution of morphia for hypodermic use should be prepared about the time of the expected administration. Even if free from foreign matter, and carefully filtered, it undergoes a change by keeping, which renders it irritating to the tissues. For this reason it is better for the physician to carry with him powders of morphia containing different quantities, and dissolve them in sufficient water when required. Clear spring, well, or cistern water, or melted ice, will answer instead of distilled water, and unless the latter be fresh and pure, it is not to be preferred. Since I have adopted the method of extempore preparation of the morphia solution, I have not had occur the hard nodules and points of suppuration which were not infrequent when the regular solutions were used.

Dr. Lawson† recommends a solution of the muri-

* St. George's Hospital Reports, vol. iv., 1869.

† Medical Times and Gazette, Nov. 12, 1870, p. 555.

ate, gr. x ad aquæ destil., ʒij. This solution is solid at ordinary temperature, and requires heating to give it fluidity. Six minims contain a half-grain of morphia.

Dose.—The dose of morphia for hypodermic use varies from $\frac{1}{12}$ to $\frac{1}{2}$ of a grain. *In commencing, it should not exceed one-third of that ordinarily administered internally.* It is prudent in all cases to test the physiological capabilities of the patient by a moderate dose before resorting to the maximum amount. Patients vary in their susceptibility. Women are, as a rule, more easily affected than men. One-twelfth of a grain is a sufficient dose for many of the conditions requiring an injection. Persons habituated to the use of the drug, or those suffering pain, will bear a larger quantity. The maximum doses may be administered with safety if combined with atropia (see *post*). As Brown-Séquard has indicated, large doses of morphia, when combined with atropia, exert a more decided curative effect in obstinate neuralgias. It may be necessary in such cases to give $\frac{1}{2}$, and even 1 grain of morphia, with $\frac{1}{48}$ of a grain of atropia.

In order to maintain a constant physiological effect, but slight increase of the dose is necessary. This is one of the greatest advantages of the hypodermic method, especially in cases requiring the protracted use of morphia.

Hypodermic injections of morphia are rarely advisable in the case of children, yet as their utility is unquestionable in certain convulsive disorders of early

life it may be necessary to employ them. From $\frac{1}{30}$ to $\frac{1}{10}$ of a grain, according to age, is a sufficient dose. I have not ventured to use the injection in children under three years of age.

As the quantity proper to be administered is differently stated by different authorities, I desire to impress upon my readers the necessity for caution. The large doses sometimes recommended—$\frac{1}{2}$, $\frac{3}{4}$, and even 1 grain—are unsafe for the first trial, unless the conditions requiring the injection be exceptional.

PHYSIOLOGICAL EFFECTS.—When the solution is injected, a pain, compounded of smarting and burning, is experienced in the part, and this is followed by some itching. The tactile sensibility, and also the sensibility to pain, is diminished at the site of the injection. In a short period of time, varying from a few seconds to ten minutes, the systemic effects are felt by the patient. A sense of heat and of fulness in the face and head, giddiness, singing in the ears, and, in many persons, nausea, are experienced. Some abdominal pain is sometimes felt, and loud borborygmi not unfrequently occur at the moment the cerebral symptoms are perceived. The vertigo impairs the voluntary control, and walking becomes uncertain, difficult, or impossible. With the manifestation of these cerebral effects, injection of the conjunctivæ and more or less contraction of the pupils occur. The face is also flushed. The mouth becomes pasty, the tongue dry, and the taste perverted by reason of the dryness of the epithelium. Deglu-

tition is also somewhat painful and difficult, owing to the same condition of the mucous membrane. The special sense of hearing becomes much more acute than normal. With the development of these physiological effects, pain, cramp, and spasm are relieved, or are borne without suffering, for a feeling of comfort and content, difficult to describe, takes possession of the mind. A condition of somnolence in many persons, in others of extreme wakefulness characterized by intense activity of the mind, is experienced. If sleep occur it is usually deep, the respiration being slow and labored. In some instances the sleep is disturbed by dreams and visions,—a somnambulistic state from which it is difficult to arouse the patient.

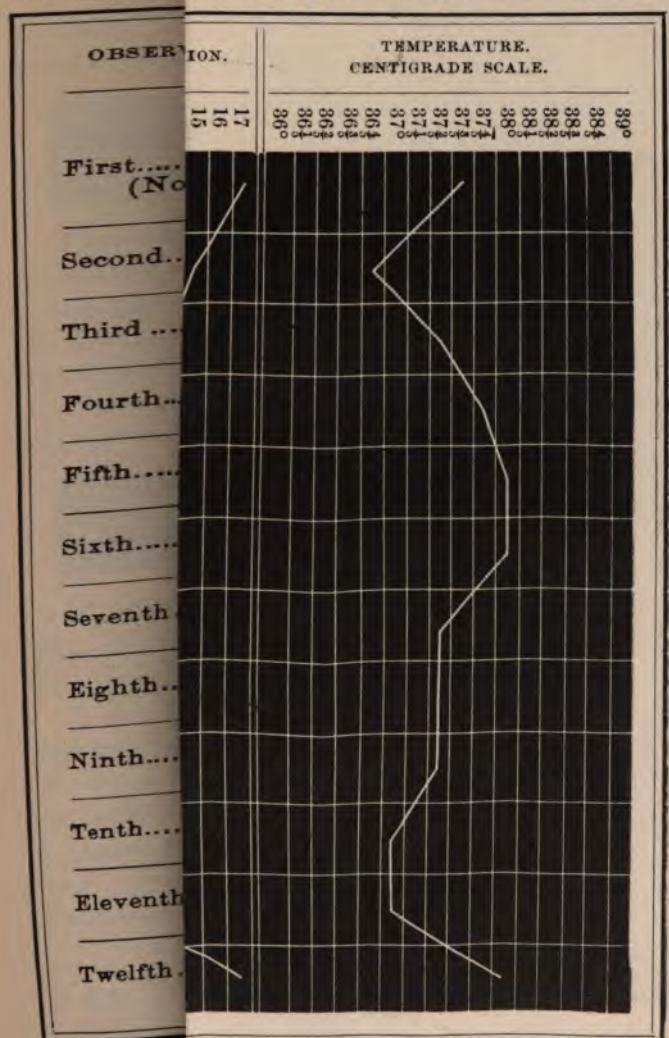
Characteristic influences are exerted upon the great functions of calorification, circulation, and respiration. It was Mr. Hunter* who first pointed out the effect of the subcutaneous injection of morphia in lowering the pulse. He informs us that "in mania he had reduced the pulse from 120 to 80 in four minutes." He observed also "the diminished rate of respiration."

In order to exhibit these effects I have constructed the annexed diagram of the pulse, temperature, and respiration movements.

The influence of morphia over the arterial tension, when administered hypodermically, is well shown in the subjoined sphygmographic tracings. I am in-

* On the Speedy Relief of Pain, etc., op. cit., p. 33.

**Observat**arter of a grain of sulphate of morphia.



Indebted to Dr. J. T. Drake for the opportunity to make these observations.

The first is the normal trace taken with a spring pressure of 200 grammes. The second, with the same spring pressure, the instrument having remained *in situ*, was taken after the hypodermic injection of one-fourth of a grain of morphia. A remarkable rise occurred in the arterial tension, as the tracing clearly exhibits.

By ophthalmoscopic examination made at the same time, I discovered a marked increase of vascularity of the retina and blurring of the papilla.*

Soon after the injection, more or less decided itching of the nose,—and in many persons during the time the morphia narcosis is at its maximum, an irritation of the whole cutaneous surface,—are experienced. This effect is usually followed by general diaphoresis,—the sweating being in many instances very profuse.

* Transactions of the Ohio State Medical Society, 1871, p. 223.

With the development of the morphia narcosis there occur dryness of the mouth and fauces and an arrest of secretion in general, except that of the sudoriparous glands. If the injection be administered after a full meal, digestion is suspended, the food remaining unchanged in the stomach for several hours. As a rule, constipation results; but to this there are numerous exceptions, for in some instances I have known the peristaltic movements to be actually increased. In common with the other organs, and possibly, also, in consequence of the diaphoresis, the functional activity of the kidneys is lowered, and the amount of urine secreted is much below the normal. More or less difficulty is experienced in the emission of urine; when the desire is felt, a long interval elapses before the flow takes place, and, as the contractile power of the bladder and of the ejaculatory muscles is diminished, the emission of urine is slow. The urine is higher colored than normal, due in part to the lessened amount of water, but also to the presence of bile pigment. The diminished excretion of bile is also represented in the yellowish hue of the conjunctivæ, the muddy tint of the skin, and the lighter color of the fæces.

With the decline in the morphia narcosis, some patients experience headache, confusion of mind, anorexia, and nausea, but these results are not so constant as after the internal use of this agent. If the injection be administered at night, the nausea and vomiting are experienced on rising in the morning.

Perfect quiet, a cup of hot coffee taken before rising, an ice-bag to the cervical spine, a full dose of the bromide of potassium, may be administered for the relief of these symptoms when they are severe.

The extent and persistence of the foregoing physiological effects will depend upon the quantity of morphia injected. Very large doses excite not only immediate disturbance in the functions of the brain, but secondary disturbances in the process of elimination of the narcotic from the blood. The occurrence of these unpleasant and depressing effects of the morphia narcosis is an additional reason for cautious tentative experiments in any case in which the physiological tolerance of this agent is unknown.

Phenomena somewhat different in character, as well as in degree, from those which I have described under this head, follow the subcutaneous injection of large doses. The following symptoms were observed by me after the injection of one grain of sulphate of morphia:

In ten minutes the patient had fallen asleep so soundly, sitting upright in bed, that he could not be aroused. At the end of an hour I found him in a state of profound narcotism, his pulse 50 and feeble; respiration 10 and labored, with stertor; skin cold and sweating; face pale and ghastly. The conjunctivæ were deeply injected; pupils minutely contracted, and insensible to the strongest gas-light. No reflex movements could be excited by touching the eyes, or by irritation of the fauces. These formidable symp-

toms were relieved by the subcutaneous injection of atropia, but the patient slept twenty hours. Great difficulty of micturition was experienced for twenty-four hours longer. Injection of the conjunctivæ, huskiness of voice, and some difficulty in swallowing persisted for forty-eight hours.

The effects of an ordinary dose, ¼ of a grain, continue from twelve to eighteen hours, according to the susceptibility of the patient. It follows, then, to maintain the morphia influence in any given case, two doses per diem will, generally, be sufficient.

Are there any ill effects produced by the long-continued use of morphia when injected under the skin? This is a practical question of considerable importance. I have not observed effects different in character from those produced by the long-continued internal administration, except in one case. In this instance extreme volubility, complete insomnia and restlessness were induced by the subcutaneous injection of half a grain of morphia every four hours. This patient, the unhappy subject of uterine cancer, was advised by her physician to use for the relief of her pain the hypodermic injection of morphia. As the attendants of this woman used the syringe, they were prevailed on, by the extreme suffering which she endured, to increase the dose to the point named. At the end of three months she began to be restless, and complained that the effect of the morphia was no longer the same. She could not sleep; her restlessness became extreme; her extremities and the

muscles of her head and face were agitated by choreic spasms; her eyes were brilliant and constantly in motion; she talked incessantly, partly in a perfectly rational manner, and partly in a delirium of a busy but harmless character. Her hallucinations were agreeable, and her countenance exhibited no appearance of distress. Her pulse was 96; respirations 20. The quantity of morphia which this poor woman received was evidently too great; the brain was permitted no respite from the narcotic influence. If atropia had been combined with it, or if the doses had been less frequently administered, these effects had probably not supervened. Eulenberg reports a case in which 1200 injections were used without injury to the patient.

In a case of epileptiform tic-douloureux of great severity occurring in my practice, the hypodermic injection of morphia was used twice each day for two and a half years, being in all about 1800 times, and was then withdrawn gradually without any ill effects whatever.

Another case has come under my observation in which three injections were practised daily for three years. The patient, a gentleman of Texas, had suffered a severe fracture of the leg. Hypodermic injections of morphia were used to relieve the pain and sleeplessness. He became so enamored of the morphia sensations as to continue the practice himself, and he continually increased the amount injected until it reached 3i each week. He was pale, thin,

and rather cadaveric in appearance, and his eyes were sombre, giving his countenance a weird expression. When the effects of the morphia subsided, he experienced "morphia horrors," but when under the influence of his usual dose he was cheerful, active, and attentive to his affairs.

I have under observation another patient sixty-two years of age, who, for a painful affection of the bladder, has taken twice each day a hypodermic injection of ½ grain of morphia for two years. He has had on two occasions morphia horrors, which required large doses of the bromide of potassium, but his bodily and mental activity are at present at their maximum of efficiency, and his malady has been most decidedly ameliorated.

In consequence of these facts and others which I have observed, I cannot admit the correctness of Clifford Allbutt's deductions in regard to the prolonged use of morphia hypodermically administered.* That morphia used in this way will induce a habit, in all respects similar to, only more enslaving than, the use of opium internally, is certainly true, and we constantly meet with patients who habitually use the hypodermic syringe as we formerly encountered "opium-eaters."

But the question is—do we find that the prolonged use of morphia, hypodermically administered, gives

*On the Abuse of Hypodermic Injections of Morphia. The Practitioner, vol. v. p. 327.

rise to symptoms different from and more serious than those brought about by opium-eating? Dr. Allbutt alludes to a class of cases, neuralgia chiefly, in which the morbid state of the nerves seems to be kept up by repeated morphia injections; but is not this the case with opium-eaters as well?

THERAPY.—The subcutaneous injection of morphia may be used to relieve pain, to relax spasm, to subdue inflammation, to cure specific diseases, and to antagonize toxic agents. An anatomical arrangement seems best adapted to embrace all of the therapeutical facts under these several heads. Accordingly, I shall consider the uses of morphia in

Diseases of the Brain and Nervous System.
" " Respiratory and Circulatory System.
" " Digestive Apparatus.
" " Genito-urinary Organs.
" of Constitutional or Specific Origin.
In certain Surgical Diseases and Operations.
As a Physiological Antidote.

*Diseases of the Brain and Nervous System.*

**Psychical Disorders.**—Mr. Hunter was the first to indicate the utility, and to employ the hypodermic injection, of morphia in the treatment of *psychical disorders.* He enunciated an important truth in the following observations: "For derangements of the cerebral nervous system we have in the hypodermic method a means of treatment far super-

seding in its immediate efficacy any other mode of medication." In another place he further remarks: "In this class of cases (mania) a single dose, administered beneath the skin, will at once break the neck of the disease. It will often, at once, stop the delirium, correct the mental aberration, and remove the exhaustion."* Notwithstanding the striking advantages thus shown to result from the hypodermic treatment of mania, some years elapsed before it came to be employed. Indeed, so late as May, 1869, we find a distinguished asylum superintendent† repeating the expression of Dr. Anstie, "that despite the satisfactory working of the hypodermic method, and of the greatly increased power of handling remedies which it gives us, it is still very much unappreciated." Dr. Robertson believes that "this remark applies to the employment of the hypodermic injection of morphia in the treatment of mental disease." According to the same authority, Dr. Mackintosh published a paper in 1861 on "The Subcutaneous Injection of Morphia in Insanity," and the reports of the Somerset Asylum contain allusions to the advantages of this method. Lorent,‡ Erlenmeyer,§ and Eulenberg‖ support the observations of Hunter by their

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* On the Speedy Relief of Pain, etc., pp. 18, 19.
† C. Lockhart Robertson, in Practitioner, May, 1869, p. 272.
‡ Die hypodermatischen Injectionen, etc., op. cit., p. 16.
§ Die subcutanen Injectionen, etc., op. cit., p. 28.
‖ Die hypodermatische Injection, etc., op. cit., p. 154.

individual experiences. Maudsley,* who places opium at the head of all the remedies employed in the treatment of insanity, considers the subcutaneous injection of morphia "a valuable expedient." Reissner,† who has experimented largely with the hypodermic method in the various forms of mania, comes to conclusions less favorable than above expressed. In acute mania he had no permanent good results. Dr. Vix has, however, adduced a remarkable case in which a single injection of morphia cured a recent case of acute mania. In melancholia, Reissner's results were not more favorable than in acute mania. In chronic mania, the effects were variable: some patients were calmed for weeks and months; in others, large doses were without benefit. Reissner considers general paralysis unsuited for the action of morphia, and that it is contraindicated in cases of mental disorder complicated with heart or stomach disease, rigidity of the arteries, tuberculosis, and in certain epileptics.

More recently, Dr. O. J. B. Wolff has attempted a more accurate determination of the indications for the use of morphia, subcutaneously, in mental diseases. The state of the arterial tension is Wolff's guide to the use of morphia. If the sphygmograph shows a low state of the arterial tension with a slow pulse, small doses are indicated. On the other hand,

* Reynolds's System of Medicine, vol. ii. p. 60.

† Bulletin Général de Thérapeutique, Jan. 30, 1870, p. 89.

as large doses of morphia, by over-excitation, cause paresis of the sympathetic, these are indicated when the pulse is quick and tension high. He advises caution in the use of large doses in the obese and the aged. He thinks the subcutaneous injection of morphia very useful in both curable and incurable cases.*

Krafft-Ebing reports excellent results from the use of morphia subcutaneously in cases of lypemania, especially when there exist at the same time neuralgic troubles. He has been equally fortunate by this method in the treatment of "moral hypochondriasis complicated with hyperæsthesia of the spinal cord," and "in forms of mental alienation determined sympathetically in the predisposed by neuralgias and neuropathies." The existence of a neuralgic element constitutes an indication for the use of morphia, subcutaneously, in simple mania and in hysterical mania. Krafft-Ebing considers the same mode of treatment the most efficacious for the relief of the insomnia so common in the insane.† My own experience, which has been limited, however, is very favorable to the subcutaneous injection of morphia. In a case of acute melancholia, characterized by insomnia and intense restlessness, I found this method of treatment exceedingly useful. A grain of morphia

* Archiv für Psychiatrie und Nervenkrankheiten, Band ii.
† Bulletin Général de Thérapeutique, Jan. 30, 1870, p. 474.

reduced the pulse from 140 to 96, quieted the agitation, and procured sound and refreshing sleep.

Robertson in the paper referred to gives three typical cases of different forms of insanity—recent mania, chronic mania, and melancholia—in which the hypodermic injection was successful. The indications for the employment of this method are the following:

Prolonged wakefulness.

Maniacal excitement.

Obstinate and persistent refusal of food, or drink, or medicine.

Destructive and suicidal tendencies.

Maudsley adds a caution here, which I transcribe for the benefit of my readers: "It will be well to have in mind that neither opium by the mouth, nor morphia hypodermically injected, will always quench the fury of acute mania, and that successive injections of morphia, followed by brief snatches of fitful sleep, have been followed, also, by fatal collapse."

The evidences of the beneficial effect of the injection are the following:

Prolonged and healthy sleep.

Less excitement on awakening.

Illusions or delusions less strong.

Willingness to take food.

Absence of any tendency to collapse, although pulse, temperature, and respiration are reduced.

To produce the best results, larger doses than those I have indicated as proper in general are necessary in the treatment of mania. Hunter administered ½ and 1 grain; Robertson speaks of ½ grain of the acetate of morphia injected every four hours, and in one case of 1 grain injected night and morning. In cases which have occurred under my observation, extraordinary tolerance of the morphia was exhibited; and in that case to which I have made special reference, 1 grain was found necessary to procure sufficiently prolonged sleep.

It is in the beginning of mania that the hypodermic injection of morphia is most conspicuous for good. The timely use of the syringe may avert this disorder in that critical period when the occurrence of unusual excitability and sleeplessness indicates that an outbreak is imminent. This observation is especially true of puerperal mania. The introduction of chloral hydrate has modified somewhat the treatment of maniacal affections by the subcutaneous use of morphia; but, as Wolff has shown, each has its own sphere of applications.

**Delirium Tremens.**—We owe to Mr. Hunter the first suggestion of the hypodermic treatment of *delirium tremens*. It was afterward employed by Ogle, Semeleder, Lorent,* Eulenberg,† Ruppaner,‡ and others. Dr. Anstie, in an able paper on "Alco-

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* Op. cit. † Op. cit.

‡ Hypodermic Injections, 2d ed., p. 132.

holism,"* thus formulates his views as to the utility of this method:

"Opium should never be administered by the stomach, but always in the form of morphia hypodermically injected, in the dose of $\frac{1}{10}$ to $\frac{1}{4}$ or $\frac{1}{2}$ grain."

The treatment of delirium tremens has undergone a radical change within the past few years. This is well expressed in the following observations by Dr. Anstie:

"In former times—indeed, a very few years since—the notion universally prevailed that the delirious symptoms were owing to the exhaustion which was chiefly kept up by want of sleep; and, consequently, that the production of continuous sleep for several hours was the sole and all-important means of cure. It was therefore the custom to ply the patients with larger and larger successive doses of opium, with the view of drowning the delirium in narcotic stupor. Great mischief arose from this wide-spread belief and practice. In the first place, it has often happened that the patient, without ever sleeping at all, has passed first into a condition of coma-vigil, next of stertorous breathing, and at last sunk, fairly poisoned with opium."†

I have quoted these strong but just expressions to warn my readers against the abuse of the hypodermic

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* Reynolds's System of Medicine, vol. ii. p. 90.

† Ibid., pp. 88, 89.

injection of morphia in the treatment of delirium tremens.

The following are the indications for the use of this method in this disease:

The condition of "horrors," or wakefulness, preceding delirium.

Excessive and uncontrollable vomiting of food, drink, and medicine.

Mild cases, in which there is little tendency to depression of the vital forces, in which the assimilation of food proceeds satisfactorily.

It is contraindicated in severe and protracted cases, with great depression of the vital forces and non-assimilation of food;

In cases in which serious organic lesions of liver or kidneys have occurred;

In cases in which the delirium tremens is consecutive to traumatic or other serious lesion of brain.

In **cerebro-spinal meningitis** opium is the best remedy, especially in the onset of that disorder, and according to Radcliffe,* the hypodermic injection of morphia is the best method of administration. Erlenmeyer,† who appears not to have had any personal experience with the hypodermic use of morphia in this disease, refers to the experience of Bois. According to Eulenberg,‡ Niemeyer used this method

* Reynolds's System of Medicine, vol. ii. p. 702.

† Die subcutanen Injectionen, op. cit., p. 31.

‡ Die hypodermatische Injection, op. cit., p. 156.

as a palliative in an epidemic at Rastadt and Carlsruhe. It relieved the pain and cramps, and quieted the extreme restlessness (*gross Unruhe*), which are marked phenomena in these cases. Dr. B. Arnold, of Donzdorf, reports favorably of its use in these cases.* According to Stillé,† the opium treatment was very serviceable in the disease as he observed it in Philadelphia. The author's experience is fully confirmatory of the published observations. He has witnessed remarkable cures effected by the timely, and even heroic, use of morphia, subcutaneously. It is especially serviceable in the early stage—stage of irritation—and ceases to be useful when depression of function—paresis—occurs.

In the psychical disorders *insomnia* is a prominent symptom, for the relief of which the morphia injection is especially indicated. When insomnia is the substantive disorder, a combination of morphia and atropia is better than morphia alone,—a fact which I shall develop in a future chapter.

In the treatment of **coup-de-soleil, sunstroke,** very unexpected and gratifying results have been obtained by Dr. Hutchinson, at the Pennsylvania Hospital.‡ He injected one-fourth of a grain of the sulphate of morphia, which produced almost instant relief, and was followed by rapid recovery.

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* Schmidt's Jahrbücher, vol. cxxvii. s. 163.

† Epidemic Meningitis. Philadelphia, 1868.

‡ Pennsylvania Hospital Reports, vol. ii. p. 291.

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al Affections. Pamphlet.
.. Practitioner, vol. i. p. 5.
iske Fund Prize Essay, 1871, p. 38.

tion, or one-fourth of a grain, will be a sufficient quantity for each injection. Notwithstanding the good effects of this practice, the certainty of inducing a morphia habit by frequent repetition of the narcotic impression is a serious objection to the method, and it is, consequently, rarely employed at the present time.

Scanzoni was the first to use the hypodermic injection of morphia in *eclampsia*. This practice was followed by Lander, Hermann, and Lehmann, with good results.* The injection is much safer than the inhalation of chloroform, almost as prompt in its effects, and quite as efficient in suspending the morbid reflex excitability. In the convulsions of infancy, whether dependent upon reflex irritation of teething, worms, indigestible food, etc., the hypodermic injection of a small quantity (one-thirtieth to one-sixteenth of a grain) of sulphate of morphia will promptly terminate the paroxysms. This treatment must be conducted with caution in very young subjects. It will be prudent, in any case, to attempt relief by the ordinary measures, especially by the removal of the cause of irritation, before resorting to so powerful an agent. The dose for this purpose should not exceed one-sixteenth of a grain, and may be sufficiently powerful in one-half this quantity (one-thirty-second of a grain).

One of the most important recent contributions

* Erlenmeyer, op. cit., p. 35.

to our therapeutical resources is the demonstration, made by Prof. Loomis, of New York, of the remarkable curative power possessed by the hypodermic injection of morphia in the *convulsions of albuminuria.* Heretofore the presence of albumen in the urine has been held to contraindicate the use of the preparations of opium; but the observations of Loomis have established the fact of an antagonism between the action of morphia on the one hand, and of that condition of the intra-cranial circulation which occurs in albuminuria on the other. In albuminuria the arterial tension is low, the perivascular lymph-spaces are distended with serum, and the brain substance is anæmic. In this state of things Traube found a sufficient explanation of the convulsions which by others were supposed to be caused by uræmia.

In the treatment of uræmic convulsions, considerable doses of morphia are not only well borne, but are demanded by the conditions present. For an adult half a grain may be administered at once, and this must be repeated promptly if the convulsions continue, or if they recur after having ceased for a time. As much as two grains may be injected within a few hours in severe cases. The author must, however, repeat the caution that such heroic medication must not be undertaken without due consideration and an accurate diagnosis.

**Chorea.**—Hunter* and Levick,† of Philadelphia,

* Loc. cit., p. 27. † American Journal of Med. Sciences.

employed the hypodermic injection of morphia in this disease with success. When the jactitations are incessant and violent, preventing sleep and causing injury to the soft parts, the patient wearing out at length, the use of the morphia subcutaneously has undoubted value. It is useful in those cases in which Trousseau* was in the habit of prescribing enormous doses of morphia internally. But over ordinary cases of chorea, as Dr. Bristowe† has shown, "specific forms of treatment have little or no real influence," and suitable hygienic means will as certainly conduct the case to a favorable termination. Nevertheless, in the very violent cases to which I have referred there is no means of treatment equal to the hypodermic injection of morphia. Generally speaking, such cases require the maximum doses, as Trousseau's use of ten, twelve, and even fourteen grains of morphia daily with success sufficiently indicates. Commence with one-fourth of a grain, and increase according to the effect produced; it will rarely be necessary to exceed one grain at a single injection.

**Tetanus and Hydrophobia.**—Hunter used the hypodermic method in cases of traumatic tetanus, "giving sleep and diminishing the spasms," but without permanent relief, death ensuing in each. Ruppaner‡ injected two cases with the liq. opii comp., which very

* Clinique Médicale de l'Hôtel Dieu, tome ii. pp. 195, 196.
† The Practitioner, No. X., April, 1869, p. 195.
‡ Hypodermic Injections, p. 136.

much assuaged the sufferings of the patients, but did not retard the fatal termination. He urgently recommends further trials with this agent. More favorable results were obtained by others. Thus Eulenberg* used it with success in a case of traumatic tetanus. In idiopathic tetanus, and in trismus neonatorum, more favorable results have been obtained, but these forms of trismus are much more amenable to treatment than the traumatic. Demarquay† obtained good results in the treatment of cases of tetanus during the second siege of Paris, by a new mode of using subcutaneous injections. He carried the needle deeply into the contracted muscles, and, if possible, to the point of entrance of the nerves. He thus injected the masseters, the muscles of the neck, the sterno-cleido-mastoid, the sacro-lumbar muscles, etc. He used in this way one to two grains of the muriate of morphia daily, with the effect to relax the spasms and permit the nourishment of the patient. Of three cases treated in this way, two recovered and one died; but the fatal result in this case was due not to the tetanus, which was relieved by the injections, but to pyæmia. The subcutaneous use of the extract of Calabar bean, or of physostigmia, is much more effective in the treatment of tetanus.

The sufferings of the patient affected with *hydro-*

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* Op. cit., p. 136.

† Bulletin Général de Therapeutique, 15th October, 1871, p. 299, et seq.

*phobia* may be much diminished by the hypodermic injection of morphia, but I am aware of no case in which the fatal termination has been averted.

**Local Muscular Cramp and Spasm.**—Eulenberg has used the subcutaneous injection of morphia in the muscle-spasm succeeding amputation of the thigh. I have obtained the greatest advantage from this method of treatment in the painful jactitations of the muscles which occur in cases of fracture. In a case of fracture of the femur on the paralyzed side of a hemiplegic patient, the injection procured instant relief to the very violent and persistent muscular spasms which occurred in a few hours after the injury. As is well known, Dr. Marshall Hall was the first to point out the fact that in paralysis of cerebral origin the muscular irritability is not lost. This fact is also admitted by Duchenne de Boulogne.* In the patient to whom I refer the muscular irritability existed in an exaggerated degree. Besides the pain which the violent spasm produced, union of the fractured femur would have been impossible if no means had existed for terminating the muscular spasms.

**Neuralgia.**—The greatest triumphs of the hypodermic method have been achieved in the treatment of neuralgia. As Dr. Anstie, in the able article already referred to, remarks, "The advantages of morphia, hypodermically administered, over opiate

* De l'Électrisation Localisée, etc. Deux. édition, 1861, p. 338.

medication by the stomach, are such as would be *a priori* incredible, nor can they as yet be fully explained. In particular, it is impossible to account for the far greater *permanence* of its action in relieving nerve-pain, which is so marked that its discovery has initiated quite a new era in the treatment of severe neuralgias."*

Following the classification of Valleix, the neuralgias are divisible into two classes:

I. Superficial Neuralgias.

II. Visceral Neuralgias.

The first class is subdivisible into the following:

Trifacial.

Cervico-occipital.

Cervico-brachial.

Intercostal.

Lumbo-abdominal.

Crural.

Sciatic.

The second class will be more conveniently referred to in connection with internal diseases.

It would be unprofitable to devote space to a special consideration of nerve-pain according to its anatomical seat, for the principles of treatment are the same. I propose to make observations on the most important varieties, to illustrate the hypodermic treatment in all.

Neuralgia of the fifth nerve, or trifacial, is the

* Op. cit.

most important of the whole group. It occurs more frequently, is more painful, and is more difficult to cure. But from the lightest case of facial pain, due to irritation of decayed teeth or cold, up to the atrocious and incurable epileptiform tic, there are numerous gradations in respect to severity and curability.

In *toothache* the hypodermic injection of morphia is often immediately curative. It is, of course, less permanently beneficial when caries exists, but even in this case it affords great relief. It may also be used to diminish the pain of extraction. The facial neuralgia of pregnancy is promptly cured by it, as I have repeatedly ascertained by trial. This fact was first pointed out, I believe, by Dr. H. R. Storer, of Boston, the eminent gynæcologist of that city. These cases, as is well known, are extremely obstinate under the old methods of treatment, and those who have suffered from them on former occasions are exceedingly grateful for the relief so promptly and permanently afforded by the hypodermic method.

The attacks of neuralgic pain experienced in any portion of the distribution of the fifth are readily relieved by the same means. This remark is true of *migraine, hemicrania, clavus hystericus*, and other forms of neuralgic headache. I need hardly remind the reader that this method of treatment is not proper in that form of headache which often precedes, and is a symptom of, cerebral hemorrhage. That severe and obstinate neuralgia of the fifth known as *tic*

*douloureux* is generally curable by the hypodermic injection of morphia, and if not curable, is always much ameliorated by this means. A single or two or three injections may not suffice, but the persevering use of full doses may at length be successful. In obstinate cases the dose may be raised from one-fourth to one grain twice a day. Even that intractable form of *tic douloureux* described by Trousseau,* under the name "epileptiform neuralgia," may be much ameliorated by this means, and the existence of the patient elevated from a condition of abject misery to comparative comfort. The extent of the curative influence exerted by the hypodermic injection in cases of *tic douloureux* will depend upon the age of the patient, and upon the presence or absence of structural changes in the nerve or in the brain. Certainly the injection, properly used, will render unnecessary those severe surgical measures sometimes practised (section of the nerve) for temporary relief to the agony which the patient endures. I cannot too strongly insist that for decided relief of these severe cases very large doses are necessary—one grain twice a day. It is quite common to hear that hypodermic injections have been tried in a certain case, and have failed; but upon inquiry it will be found that they have not been properly made, or that a sufficient quantity of morphia has not been used. In a case of severe epileptiform tic, now in my

* Clinique Médicale, tome ii. p. 100, et seq.

charge, a hypodermic injection had been used by another practitioner without avail, but in my hands a half-grain of morphia does not fail to induce sound and refreshing sleep for the whole night, and great comfort and freedom from pain for some hours on the following day. What is equally gratifying in this case, the epileptiform convulsions have been rendered notably milder.

*Cervico-occipital* and *cervico-brachial neuralgia* are more amenable to treatment than *tic douloureux*. A few injections of morphia will generally suffice to cure them.

I have had most gratifying success in the treatment of herpes zoster by this means. The hypodermic injection at once suspends the severe pain and burning (intercostal neuralgia) which accompany this disease, and cuts short the duration of the eruption.

Next to the severer forms of tic, the most troublesome neuralgic disorder with which we have to deal is *sciatica*. I may affirm with regard to this what Dr. Anstie has remarked about epileptiform tic, that the hypodermic method has inaugurated quite a new era in its remedial management.

In severe and protracted cases, in which changes in the nerve and in the nutrition of the limb have taken place, permanent relief cannot always be guaranteed to the patient; but the injections steadily continued in the maximum doses will, in a great majority of cases, effect a cure finally. When

morphia fails, atropia may be tried, and *vice versa;* or both, as is preferable in my experience, may be employed together.

Dr. Lawson,* who has not only had an unfortunate personal experience with this troublesome malady, but has had a number of cases under treatment, concludes that the hypodermic injection of morphia "*is almost the only remedy for sciatica.*" He advises the injection to be made into the thigh four inches below the hip-joint, and over the course of the nerve.

The other varieties of neuralgia call for no special comment. The principles of treatment are the same in all.

Notwithstanding the utility of hypodermic injections of morphia in the treatment of neuralgia, no judicious physician will rely upon them exclusively in the management of severe cases. Anæmia must be corrected by iron, cod-liver oil, the hypophosphites, etc. A suitable dietary and hygiene must be enforced. Meanwhile, if the pain is not permanently relieved by the injections, the existence of the patient is rendered endurable while a proper remedial management is being pursued.

Is it necessary to confine the limits of the injections to the site of pain, or to the painful spots? I have already indicated my belief that the position of Mr. Charles Hunter is, in the main, correct,—that "lo-

* Medical Times and Gazette, Nov. 12, 1870, p. 650.

podermic injection of morphia or atropia. Prof. Sée,* influenced by theoretical considerations, condemns the internal use of opium. "Opium," he says, "acts inversely to belladonna; it diminishes the frequency of breathing to the damage of the patient." He therefore recommends belladonna, a medicine styled by him "a vascular agent." Clinical experience is opposed to these theoretical views. I have ascertained that the hypodermic injection of morphia produces the following results in asthma:

It promptly relieves the paroxysm, enabling the patient to lie down and sleep.

It lengthens the interval between the attacks.

It renders succeeding paroxysms milder.

Ordinarily, I combine atropia with the morphia, in order to give large doses with safety; for in this disease, as in many other neuroses, the maximum doses are often required to accomplish relief. Prof. Hirtz has also found that the subcutaneous injection of morphia produces "marvellous results" in asthma. Although after an extensive use of this treatment I cannot affirm that any cases have been cured, I can assert that, besides the immediate relief, permanent amelioration has been obtained in all submitted for any length of time to the treatment.

In any ordinary case of spasmodic asthma, five minims of my solution, or one-sixth of a grain, is a sufficient dose to commence with.

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* Practitioner, July, 1869, p. 1, et. seq.

The above remarks on the treatment of asthma stand just as they appeared in the first edition of this work. Since that time, and very recently, by Vulpian, observations have been published showing the remarkable good effects obtained by this treatment in cases of asthma. Papers have lately appeared on this topic, in which their authors speak with the enthusiasm of discoverers.

**Catarrh.**—In chronic catarrh, to moderate the cough, diminish expectoration, and to relieve the difficulty of breathing, the injection has been used with more or less advantage by Jarotzky and Zülzer.* I have used the injection, as a palliative, with much satisfaction in similar conditions.

**Emphysema.**—The hypodermic injection of morphia relieves the dyspnœa which attends emphysema as promptly as the asthmatic paroxysm. In this disease it has been used by Pletzer, Waldenburg, Kirkes, Jarotzky,† Lorent,‡ and others. It is merely palliative. In that spasmodic affection of the diaphragm, hiccough, which is sometimes obstinately persistent, the hypodermic injection affords prompt relief.

**Pleuritis.**—Nothing can be more satisfactory than the treatment of pleuritis by the hypodermic injection of morphia; the pain is immediately assuaged, and the morbid process arrested or diminished in violence. All therapeutists now admit the curative power of

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* Erlenmeyer, op. cit., p. 40. † Ibid.

‡ Die hypodermatischen Inject., op. cit.

*Diseases of the Digestive Apparatus.*

Whenever opium or the alkaloid morphia is indicated in any case of disease, and anorexia exists, the remedy should be administered by subcutaneous injection; such is the formulated expression of Dr. Anstie. Although morphia, when exhibited in suitable doses hypodermically, is much less apt to produce nausea and vomiting than when taken into the stomach, these unpleasant after-effects are not always absent after the former mode of administration. It is certainly true, however, that the hypodermic method does not nearly to the same extent interfere with digestion and assimilation.

**Dyspepsia.**—Dr. Clifford Allbutt,* of Leeds, England, is an enthusiastic advocate of the hypodermic injection of morphia in nervous dyspepsia with intolerance of food. I have myself seen cases in which the action of morphia was as happy as it proved in the hands of Dr. Allbutt. The relief which it affords is great in *gastralgia*. By allaying pain, arresting vomiting, and saving waste to the system at large, the hypodermic injection of morphia contributes powerfully to the cure of *gastric ulcer*. It is a remedy of the greatest value in the treatment of *acute gastritis*, quieting the viscus until the morbid process subsides, and obviating the necessity for the stomach administration of anodyne drugs.

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* The Practitioner, vol. ii., 1869, p. 341.

One-fourth of a grain is a sufficient quantity to be injected daily in cases of dyspepsia, gastralgia, and ulcer. In acute gastritis, this quantity may be necessary every four or six hours. The site of the injection is of little consequence, but patients generally prefer the epigastric region.

**Scirrhus.**—In cases of *scirrhus* of any portion of the digestive tract, especially of the stomach, no palliative is comparable to the hypodermic injection of morphia. The existence of a patient afflicted with scirrhus of stomach is not only prolonged, but is rendered comparatively peaceful and calm, by this treatment, for it diminishes or arrests the vomiting, enables the food to be assimilated, gives freedom from pain, promotes sleep, and thus saves the strength.

**Cholera.**—The most instantaneous and striking relief is afforded by the hypodermic injection of morphia in *sporadic cholera.* It is indicated in this disorder after the irritant cause, whatever it may be, is evacuated from the intestinal canal. From one-sixth to one-half a grain, according to the severity and violence of the attack, may be injected into the epigastrium. The subcutaneous injection is strongly indicated in *epidemic* or *Asiatic cholera.* In this disease, the gastro-intestinal mucous membrane is not in a condition to appropriate remedies; hence the subcutaneous method is eminently rational.

Dr. Patterson,* of the British Seamen's Hospital,

* Medical Times and Gazette, Jan. 27, 1872.

Constantinople, has employed the hypodermic injection of morphia in a recent cholera epidemic. Of 10 cases "treated in the usual manner," 9 died and 1 recovered. Of 42 cases treated by morphia subcutaneously, 22 recovered and 20 died. Of these 42 cases, 8 were *in articulo mortis* when admitted, 1 had a severe disease of the liver, 1 was far advanced in consumption, 1 was sixty years of age, 1 was near her confinement, and 3 were intemperate. Dr. Asche* treated two cases of cholera by this method successfully. According to the author's experience, for the first symptoms in cholera, the morphia injection is the most serviceable remedy, but when cramps occur and collapse is imminent, morphia must be supplemented by chloral. A combination of these agents possesses peculiar curative power in true cholera, as the author has ascertained by actual trial.

**The Vomiting of Pregnancy** has been relieved by the hypodermic injection when all other means had failed. For the milder cases this treatment is unnecessary and improper; but in those severe cases in which life is reduced to the lowest ebb by the continual vomiting, and in which forced abortion has hitherto seemed the appropriate remedy, it is eminently successful. In all severe cases in which the ordinary remedies fail to give relief, recourse should be had to the hypodermic method. A daily morning

* Schmidt's Jahrbücher der Gesammten Medicin, Band 125, s. 231–7.

injection ($\frac{1}{12}$ to $\frac{1}{4}$ grain) administered during the period of greatest difficulty, will enable gestation to proceed without danger to the mother, and without the necessity of adopting that serious alternative—abortion.

**Colic.**—In my practice I employ no other means of relieving the pain and spasm of colic. In most of these cases, of course, further treatment is necessary: constipation must be relieved; obstructions be overcome; the saturnine cachexia be removed; but the injection, by relieving spasm of the muscular layer of the bowel, permits these effects to be produced much more easily and speedily than would otherwise be possible. Cases of hepatic colic, within the range of my observation, have been quickly relieved by the hypodermic injection of morphia, where opium internally failed to produce the least mitigation of the pain, and where the inhalation of chloroform procured only the most temporary respite. When pain is very excessive, the reader should remember small doses may not suffice, but one-fourth and even one-half a grain may be necessary, repeated according to circumstances.

The same observations are applicable to *nephritic* and *uterine* colic.

**Peritonitis.**—Opium being the remedy *par excellence* for inflammation of serous membranes, the hypodermic injection of morphia should be employed in all cases in which promptness and completeness of effect may be desired. This is especially the case in

peritonitis, whether primary or secondary. Moreover, as in many cases of this disease the alimentation is of prime importance, and as nausea and vomiting are frequently present, the stomach administration should be deprecated, and the hypodermic be preferred.

**Neuralgia.**—In the various forms of neuralgic pain which affect the abdominal organs, whether *gastralgia*, *enteralgia*, *hepatalgia*, *nephralgia*, etc., no remedy procures so prompt and, in many cases, complete relief as the hypodermic injection of morphia.

**Constipation.**—In many cases of colic due simply to constipation, the injection not only relieves the pain but overcomes the constipation. It is true that in many cases the first injection temporarily suspends the peristaltic movements, but when habitually used this effect disappears, and the normal movements are not diminished, but promoted. Cases in which constipation existed have thus been corrected during a course of hypodermic injections. A physiological fact which I have already noted throws light upon this: in a few seconds after the injection borborygmi and distinct intestinal movements are observed. If, then, constipation exist in cases in which it may be desirable to use the hypodermic injection of morphia, this circumstance need not be considered a contra-indication.

*Diseases of the Genito-urinary Organs.*

I have already indicated the utility of the hypodermic injection of morphia in nephralgia and nephritic colic. Lorent* refers to its use in parenchymatous nephritis, to relieve the headache of uræmic intoxication. To this experience must be added the remarkable observations of Loomis, in respect to the exceptional utility of morphia injections in uræmic convulsions. When, however, the action of the kidneys is deficient, excretion lessened, or elimination checked, morphia is contraindicated.

**Affections of the Bladder and Urethra.**—In cases of chronic cystitis, I have given great relief by the hypodermic injection. It suspends those violent expulsive efforts which occasion the principal suffering. In *acute cystitis* the injection, by procuring quiet to the organ, and by diminishing the irritability of the mucous membrane, will directly contribute to the cure. The sufferings of the patient afflicted with *calculus* may be thus prevented until operative measures can relieve him permanently. *Spasm of the bladder* is quickly relieved by the same means; as also that painful but obscure affection, "the bar," which sometimes succeeds too violent and prolonged sexual intercourse. The hypodermic injection may also be used to relieve *spasmodic stricture,* but for this purpose it is by no

* Die hypodermatischen Injectionen, op. cit.

means equal, in my experience, to chloroform. It is convenient to blunt the sensibility preliminary to the operation of catheterism, and is a capital means for relieving *chordee*, and prolonged and teasing erections. But to prevent unpleasant erections and nocturnal losses, the use of morphia and atropia together is preferable to morphia alone. For information on this subject I refer the reader to the chapter on "Morphia and Atropia."

The hypodermic injection of morphia is capable of a variety of important uses in obstetric practice. It promptly arrests those *false and irregular pains* at the beginning of labor, which annoy the woman without advancing the case. In primiparæ, it has been used to diminish the sufferings of labor. It is much better than morphia by the stomach to procure rest and sleep during a prolonged first stage. No remedy is equal to the hypodermic injection of morphia for the relief of *after-pains*. In all of these circumstances no fear need be entertained that the judicious use of the injection will interfere with regular uterine contractions. The quantity to be administered will vary from one-sixth to one-fourth of a grain; the latter amount need rarely be exceeded.

The pain of *dysmenorrhœa* can be promptly relieved by subcutaneous injection of morphia; but for all pelvic pain, as Dr. Anstie has remarked, atropia is the best remedy. As a palliative in *scirrhus of the uterus* and of the *mammæ*, the hypodermic injection of morphia is much superior, in respect of economy

and effectiveness, to the stomach administration of the same drug. Lastly, on this topic, in all cases of severe pain involving any of these organs the hypodermic injection of morphia is indicated.

**Diseases of Constitutional or Specific Origin.**—Dr. William Henry Fuller writes enthusiastically of the great value of the hypodermic injection of morphia for relieving the pain of acute rheumatism. I shall have some remarks to make in a succeeding chapter upon the use of morphia and atropia in that disease, and will not now anticipate. I have used with great advantage the hypodermic injection of morphia to relieve the *nocturnal pains of tertiary syphilis.* Besides the complete and permanent relief to the pain which I have procured by persistence in the injections, I have observed, also, remarkable improvement in the lesions of bones and muscles. Not only in syphilitic but other forms of disease in which pain precedes, and in which an altered condition of the nerves produces structural changes, I have observed that relief to the pain is followed by cessation of the morbid process in the part. This fact is well shown in zoster, an affection of the skin dependent upon some functional disturbance of its sensory nerves, which disappears very promptly after relief of the hyperæsthesia. Of course, in syphilitic neuralgia, the hypodermic injection should not be used to the exclusion of the iodide of potassium. In the cases in which I have employed it the pain persisted notwithstanding repeated use of large doses of the iodide,—

a condition of things not unfrequently encountered, for long use of this remedy, and to the point of saturation—to borrow a term from the chemists,—induces a tolerance fatal to therapeutical efficiency.

**In Certain Surgica Diseases and Operations.**—To prevent shock, and to relieve pain after operations and injuries, the hypodermic injection of morphia is not as much used as it should be. No means affords such relief as this in the first few hours after *fracture* or *dislocation*. The reduction of dislocations may be facilitated and the pain prevented by the injection, in cases where it is undesirable or impracticable to use chloroform. It has recently been shown* that the *reduction of strangulated hernia* is much facilitated by the same means. In all operations requiring the knife, to prevent the after-pain, to sustain the vital powers, and to maintain the necessary quietude of wounded parts, the hypodermic injection of morphia should be used.

**To aid Chloroform Narcosis.**—Bernard† made the important discovery that the use of morphia subcutaneously, previously to the inhalation of chloroform, aided materially in the production of anæsthesia, and with a much smaller quantity of chloroform, and prolonged the stage of narcosis so that continued inhalation was not required. Nussbaum, the distin-

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* The Practitioner, August, 1869.

† Bulletin Général de Thérapeutique, vol. lxxvii. p. 241, et seq.

guished surgeon of Munich, soon after made the same observation independently. He ascertained further that the subcutaneous injection of morphia prevented the after-depression of chloroform narcosis. Dr. Wm. Warren Greene, of Pittsfield, Mass., long afterward announced the same fact, without, however, being aware apparently of the discovery of Bernard and the practical application of the discovery to surgical practice by Nussbaum.

Beside the great advantage of procuring anæsthesia by a smaller amount of chloroform, and of lengthening the duration of the narcosis, it is probable that the hypodermic injection of morphia obviates the tendency to death. Under these circumstances it may well occasion surprise, that chloroform inhalation should be undertaken by the surgeon without the preliminary use of morphia subcutaneously.

**As a Physiological Antidote.**—The subcutaneous injection of morphia may be used against the toxic effects of its physiological antagonists. The chief agents having this relation to morphia are the alkaloids of the family *Solanaceæ*. In a subsequent chapter, devoted to morphia and atropia, I will state the conclusions at which I have arrived in regard to the antagonism of these two agents.

The subcutaneous injection of morphia has been used against *strychnia poisoning*, but it is not so effective as physostigma. It has been used also against *poisoning by digitaline*, but for this purpose it is inferior to atropia, amyl nitrite, and other agents.

administered for years. It will conduce to a clearer conception of the subject to treat of these two classes of morphiamaniacs in separate paragraphs.

1. *Small Doses for a Short Period.*—If the injection have been administered in a moderate quantity,—half to a grain several times a day for six months,—and at a fixed hour, the patient begins to experience characteristic nervous sensations as the time for the injection approaches; he becomes uneasy, restless, "fidgety;" he is wakeful, his senses are abnormally acute, and he has more or less headache and vertigo; his feelings are easily touched; a globus rises in the throat; nausea and troublesome borborygmi, with some intestinal pain, occur; general malaise, a sensation of fatigue, accompanied with muscular pains and decided inability for physical exertion, with depression and a cold sweat, are felt. These are the sensations, in less or greater degree, according to the time which has intervened, that inform the individual of the need of a new dose. Marvellous, indeed, is the change when the injection is practised. All the disagreeable, even painful sensations and the dreadful unrest, which had but a moment before caused an indescribable discomfort, have now vanished, and in their stead is present a feeling of perfect comfort, and an active state of body and mind equal to any effort. How grateful is the patient for the feeling of relief, and how impossible to forego the use of a drug which so transforms his feelings and imparts a glow to the world about him!

If the injections are suspended suddenly and entirely, very severe nervous disturbances are induced. An obstinate headache, vertigo, tinnitus; wakefulness, coming on after a short period of somnolence, interspersed with snatches of sleep disturbed by horrible dreams; during the waking moments an inexpressible anxiety and gloom and depression; unappeasable restlessness, with an overpowering sense of fatigue and a deep-seated aching in the members; nausea, vomiting, repugnance to food, intestinal pain, diarrhœa, sometimes of a colliquative character; very great depression of the powers of life, a weak, small pulse, becoming rapid and thready on exertion; coldness of the surface, a cold, clammy sweat, are the formidable symptoms developed by the sudden withdrawal of morphia, when used for some months in moderate quantity.

2. *Large Doses for a Long Period.*—The symptoms already detailed are present in these cases, but are more pronounced. The physiognomy of the morphiamaniac is peculiar: his face is pallid, eyes dull and glazed, pupil small and sluggish, countenance strange and weird, expression unearthly. His skin has an earthy, sallow tint, the nutrition impaired either in the direction of an increased accumulation of fat, the tissues being soft and watery, the muscles small and wanting in contractile energy, or in the way of general emaciation. Whether gaining or losing in weight, feebleness is a characteristic of the bodily state. The least exertion causes a

rapid pulse and accelerates the breathing. The appetite is poor and digestion is feeble. Great repugnance is felt to animal food, and, indeed, towards all the more substantial articles of diet, and fluids and fruits are almost wholly used. This abnormal taste is in part due to the dry mouth and cracked tongue,—physical conditions unfavorable to the sense of taste,—and in part to the poor digestion. The secretions of the intestinal canal and of its annexed organs, notably the liver, are so diminished in amount as to affect digestion seriously, hence the stools are dry, hard, scybala-like, yellow or grayish in color, and coated with tough mucus. So insensible does the mucous membrane become that the feces are retained for lengthened periods, hemorrhoids form, and an obstinate eczematous eruption appears at the margin of the anus. After a time, the retained feces set up a high degree of irritation, an acute gastro-intestinal catarrh is produced and an attack of cholera morbus occurs, with sometimes very serious depression of the powers of life. In some individuals, it is true, the hypodermic use of morphia does not impair the appetite and the digestive power, and does not interfere with the normal and regular action of the intestines; but these cases are exceptional. Gastro-intestinal attacks, such as I have described, occur in some morphiamaniacs every few weeks; in others every few months,—several times, certainly, during the course of the year. The effect of the capricious and *bizarre* appetite, of

the lessened digestive power, and of the diminished absorption, is to impair the quality of the blood,—to induce a serious kind of anæmia. None of the organs of the body can perform their functions properly under these circumstances, hence the mental and physical feebleness of the morphiamaniac. There is a function, however, which suffers especially,—the reproductive. The first effect of the use of morphia to a moderate extent is to increase the sexual feelings, but a considerable dose administered for the first time will depress or suspend the power of erection. Victims of the subcutaneous use of morphia soon lose all sexual feeling, and are deprived of the power of erection and the production of semen. During the continuance of the habit no semen whatever is secreted, and no nocturnal losses occur; when the habit ceases, the secretion of semen is resumed and involuntary evacuations again take place. Morphia suspends the function without otherwise impairing it, for we find that these subjects possess the same virility after the cessation of the morphia habit that they possessed before. The same result occurs in women. When the morphia habit is established, the menstrual function ceases and the sexual life is entirely suspended, and the woman is as absolutely without all of those feelings and instincts pertaining to her sexual relations as if they had never existed. As in man, this suspension of the sexual life is coexistent with the morphia habit, for the natural order is restored when the vice ceases.

Levinstein emphasizes the occurrence of albuminuria and diabetes in cases of morphiamania. I have made many urinary examinations in these cases and have as yet met with no instances of these maladies. It is true, in a few examples of considerable hepatic disturbance, I have noted the presence of sugar in the urine, but it was not permanent, and they could not, therefore, be regarded as cases of diabetes. Without presuming to call in question Levinstein's accuracy, it may be affirmed of cases met with in this country, that they are not due to the subcutaneous use of morphia.

The frequent use of the syringe, often the hasty introduction of the needle, and the use of a rusty and dirty needle, the injection of badly-prepared solutions, the repeated injection into certain localities, have a disastrous effect. Large, hard nodules form, which slowly suppurate, extensive sloughing may take place, and septicæmia and pyæmia sometimes occur with a fatal result. In a large proportion of these morphiamaniacs suppuration, abscesses of considerable size, and ulcers are produced. I have seen the arms, the abdomen, the thighs and legs, a mass of ulcers, of abscesses in various stages of formation, and of cicatrices.

Dujardin Beaumetz* narrates a case in which the injuries thus produced resulted in death. M. Calvelli† has collected many cases of abscesses, traumatic

* Bulletin Général de Thérapeutique, Jan. 1879, p. 87.

† Thèse de Paris.

fever, and other accidents produced by the injections, but he rightly enough refers them to the causes above mentioned,—the state of the needle, improperly-prepared solutions, and to the cachexia induced by the morphia habit. Braithwaite* reports a most instructive case of morphia habit of six years' duration, in which there occurred numerous abortions. In a new pregnancy at six months, a vast abscess formed in the thigh, from which erysipelas developed, and a high degree of constitutional disturbance came on. Nevertheless, delivery occurred at term, and an attempt was then made to stop the morphia suddenly, but most serious troubles resulted, the erysipelas reappeared, and the attempt had to be abandoned. On the other hand, some escape these accidents entirely. One of the most inveterate subjects I have ever encountered was a man living in the wilds of Texas, who used a glass hypodermic syringe that had been broken many times and mended with successive deposits of sealing-wax, until only the rusty old needle remained in view, and yet escaped all accidents. Several instances have been reported—one already quoted—in which death was produced by the suppuration and the systemic condition thereby induced. That there is a special state of the tissues induced by morphia, to which the formation of abscesses is due, is hardly admissible. The causes mentioned above are quite sufficient to account for them.

* Lancet, 1878, p. 874.

After a time the repetition of the injection does not induce any pleasurable sensations. For a few minutes after the insertion of the morphia, the patient experiences mental sensations of a most depressing kind, but gradually a condition of well-being follows, consisting chiefly in relief to the horrible mental and physical agony which comes on as the morphia influence declines.

The morphiamaniac never has sound and refreshing sleep. Although, after a period of wakefulness due to the stimulant action of the narcotic, he lapses into a condition of somnolence more or less profound, it is disturbed by dreams and visions of the most horrifying aspect, entirely without the range of human experiences. If the individual awake in the midst of these weird dreams, some time elapses before he can realize his situation, and then comes over him, like a flood, a dreadful sense of the position in which the morphia has placed him. Doubtless the visions of the English Opium-Eater, which are not realized in the experiences of those who take opium as a test experiment, were actually present during sleep or the half-waking state. It results from this condition of the brain during sleep, that the organ is not adequately rested, hence the sense of fatigue of mind which is felt on awaking, and which is removed only by the narcotic. In many subjects, ultimately, sound sleep is never produced, and a certain proportion pass into that condition of obstinate wakefulness known as *coma vigil*. The action of

morphia must then be supplemented by the bromides, chloral, etc., for this condition is one of imminent danger to the mind. In spite of all the means which can be used, some of these cases pass into a busy, active, and trembling delirium,—*delirium tremens*,—or into acute mania, or acute melancholia, with strong suicidal impulses.*

In the more severe cases of morphia habit, attacks of fever similar to ordinary intermittents take place irregularly. In my experience these attacks are usually associated with an acute gastro-intestinal catarrh, and are preceded by constipation and a much overloaded colon. They occur more usually in the summer and fall, rarely in the winter, and they may appear in regular order for several days as quotidian intermittent, or assume the remittent type, terminating in two or three days in a profuse sweat. When the paroxysms are quotidian, they are identical with quotidian ague,—there is a chill, followed by fever and a sweat. Although they may be regular, they are usually irregular, and are not amenable to quinia, but do readily yield to an increased quantity of morphia. Very great depression of the powers of life may occur in some of these cases when a chill is coincident with a severe attack of cholera morbus. I have known instances in which the objective phenomena of a seizure were similar to those of a "pernicious intermittent."

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* Leidesdorf, London Medical Record, Nov. 15, 1876.

Beside the immediate results of the morphia habit by hypodermic use, the unfortunate morphiamaniac is assailed by dangers, accidental and contingent, but nevertheless of high importance. A sudden illness, the performance of a surgical operation, may be seriously complicated if the physician or surgeon in attendance is not aware of the existence of the habit and the extent to which it is indulged. Still more serious are cases of sudden insensibility or impairment of the language faculty, for then the patient cannot communicate the fact of the habit.

Sufficient data do not exist as yet to permit an exact statement of the anatomical changes occurring in the morphiamaniac, except the anæmia or cachexia; but experiments on animals indicate that slow changes occur similar to chronic alcoholismus.

When, in the old and confirmed cases of morphia habit, an attempt is made to withdraw the morphia suddenly, the most serious symptoms are produced. Having had one experience of this kind, I shall not be again induced to repeat it, if for no other, for strictly humanitarian reasons, since the mental and physical sufferings are truly horrible. Levinstein advocates this method, and succeeds, but one may accomplish results in an asylum not attainable in ordinary practice, where the patient possesses entire liberty of action. But Levinstein's experience is not agreeable to any humanitarian. Although the details are brief, it is obvious that his patients suffer severely and are in danger of death. He describes

two degrees of collapse,—the mild and severe,—in which the patients pass into the condition of the algid stage of cholera, and may require, to save them from death, a hypodermic injection of morphia. These patients, in the attempts to reduce the dose or lengthen the interval between, suffer in the mode I have already described, but to a more intense degree. Every organ in the body revolts, and every function is disturbed. The morphiamaniac experiences a dreadful dilemma,—to continue the habit is insanity, or death by some intercurrent disease, after, it may be, years of suffering and apprehension; to discontinue is to feel every moment of time the horrible sensations already described. The author believes, and he bases his opinion on observed cases, that in many instances the habit can be cured.

TREATMENT OF THE MORPHIA HABIT.—The amount of difficulty in the treatment of any case will depend on sex, constitutional peculiarities, the length of time the habit has continued, and the *per diem* quantity which has been administered. When the physician or an attendant has administered the injections, and the patient has not acquired the method, the task is comparatively easy. I have usually succeeded by following these rules:

Never stop the injections suddenly.

Diminish the dose very gradually, without the knowledge of the patient.

Never use morphia alone for a lengthened period, but with atropia.

... shall increase the propor-
... the effects of the latter

... morphia are fully expe-
... generally begin to complain
... of its peculiar influence, has
... will desire that it be discon-

... breaking up the morphia habit
... the case of confirmed subjects
... syringe themselves for years.
... be pursued in these cases? I
... tion that the morphia should be
... diminished,—so gradually as to make
... the moral strength and the self-
... patient is required to suffer the hor-
... produced by the want of morphia
... fail, for he will prefer indulgence
... death. The patient's co-operation
... and he must decide for himself that
... be made. Strangely enough, the
... impatience must be held in check.
... influence of the morphia they have
... their self-control, and they de-
... duction shall be at once made.
... ld to these importunities, for
... e comes rolling in they are
... when cheating begins the
... s a fundamental rule,—
... *sible degrees.*

The patient must give up the custody and use of the syringe to some one else, and must have the quantity necessary to make him comfortable at certain regular intervals, and without failure. If the daily quantity used is not large,—say four grains,—the syringe should be given up at once, and the morphia be administered by the stomach in proportional quantity,—*i.e.*, about three times as much. Thus, if four grains was the daily allowance subcutaneously, at least twelve grains will be needed by the stomach. The rule may be formulated as follows: *Give by the stomach a sufficient quantity to make and keep the patient comfortable.* It is a most important advantage gained to exchange the subcutaneous mode of administration for the stomachal,—for, although the effect is slower in the latter, it is better maintained, and the patient experiences less sudden and severe changes in his feelings. What is even more important, the chain of morbid associations connected with the hypodermic syringe is broken up, and the patient feels hopeful, and anticipates release from his bondage because already freed from the necessity of puncturing his skin.

When the *per diem* allowance of morphia hypodermically is from one scruple to a drachm, considerable reduction must take place before the syringe can be abandoned, but it should be dropped at the earliest moment.

The rate of reduction should not be more rapid than one-sixteenth of a grain hypodermatically, and

one-fifth of a grain by the stomach, each 3 to 8 days. The necessary time must be given to it, though a year or more may be required. Haste on the part of the physician and impatience on the part of the subject will defeat the purpose in view, and when the bounds are once broken the work must be begun again. *Festina lente* is the proper rule to follow, and a wise and firm patience is the highest attribute of the physician.

Are there any aids to treatment? Is there not some drug which may destroy the appetite for the narcotic? These questions are constantly asked, and they may be answered in the affirmative, but not in accordance with popular notions. The success of the plan proposed may be facilitated by several expedients. It is of the first importance to correct the abnormal condition of the digestive functions. One or two compound cathartic pills at night will change the character of the evacuations, and induce a more healthy state of the intestines. As a stomachic and nerve tonic, a solution of strychnia in a mineral acid is highly useful:

℞.—Strychniæ, gr. i;
Acid. muriatic. dil., ℥ij. M.

Sig.—Ten minims in a tablespoonful of water three times a day, before meals.

If the stomach is irritable and the hepatic function torpid, the following prescription is serviceable:

℞.—Acid. carbolic.,
Tinct. iodinii, āā ʒss. M.
Sig.—One drop in water three times a day, before meals.

If there is merely an atonic condition of the digestive functions the tincture of nux vomica, in doses of ten to fifteen drops three times a day, may be very useful. Under the same circumstances, quinine is indicated, especially in solution with a mineral acid; or the quinine may be given in combination with iron, as in the elixir of phosphate of iron, quiniæ, and strychnia; or the tinctures of cinchona, with the other bitters, may be prescribed in combination.

The most important point in the management of these cases is the alimentation. If the morphia-maniac can take food and digest it, the difficulty in the treatment is reduced one-half. It is, in fact, a useless effort to give tonics if the food supply is wanting, or inappropriate, or undigested. Milk, egg-nog, animal broths, should be given freely, and as soon as possible steak, chops, and other substantial food. Their digestion may be aided by the simultaneous administration of pepsin, pancreatine, and mineral acids. If the stomach refuses everything else, it will probably take milk, or milk and lime-water. If but little food enters the stomach, it may be supplemented by rectal alimentation,—notably by injections of defibrinated blood, on the plan of Dr. Smith, of New York. If food can be taken in a small quantity only, it should be taken frequently, —every three hours. The supreme point is to reno-

vate the blood, so that all the organs will functionate properly. With an improved state of the cerebral nutrition there will come a more manly feeling, a firmer will, and a higher moral sense.

The use of alcohol is a highly important question. When the nervous system is losing the loved morphia impression, it will take kindly to alcohol. There is a loss rather than a gain in the substitution of alcohol for morphia, and, unfortunately, this is an exchange which has not unfrequently been made. Levinstein refers to cases, and I have known the trade to be made in both ways. Although alcohol in any of its forms must be used with caution, it is undeniably serviceable. A whisky toddy at bed-hour may induce quiet and refreshing sleep; wine at dinner in moderation will promote digestion. But I especially warn the practitioner against a procedure which the patient will be inclined to adopt, that is, to take sufficient alcohol to cause a distinct impression on the nervous system, in place of the morphia impression. This must result disastrously, for when the alcohol influence expires there will occur such a condition of depression that more alcohol or more morphia will be necessary.

To procure quiet and refreshing sleep is essential in these cases. When the morphia is very gradually diminished, the function of sleep may not be disturbed, and if proper care is used will not be. When, however, the morphia is decreased rapidly, or is suddenly stopped, the most agonizing feeling of unrest

is felt all over the body, but especially in the members, conjoined with the most absolute wakefulness. Under these circumstances chloral is extremely useful, indispensable, indeed, for by procuring sound and refreshing sleep life even may be saved. During the course of treatment chloral will be necessary now and then, but the utmost circumspection is required to prevent the substitution of a chloral for a morphia habit. The patient is always clamorous for some agent as a substitute.

Occupation is an important adjunct to the treatment, for every disagreeable sensation increases with the attention given to it. The occupation should give employment to both mind and body, and should be engrossing but not harassing. Depressing news, the ordinary annoyances of life, and especially anxiety of every kind and degree, should be removed from these patients, that there may be no excuse to justify the smallest departure from the prescribed course. Travel may be serviceable, but there are so many contingencies as to involve risk of failure in the treatment. Furthermore, there are the fewest number in a pecuniary condition to justify the attendance and the largely increased expenditure. But change of scene, in so far that the individual is removed from the associations connected with his habit, is always desirable.

## III.

### ATROPIA.

THE SOLUTION.—The sulphate is the salt chiefly employed for hypodermic use. This supplies all the conditions: it is readily soluble in water; the solution is free from irritating qualities. The formula which I employ is the following:

℞.—Atropiæ sulphat., gr. ij;
Aquæ destil., ʒi. M.

Five minims of this solution represent one-forty-eighth of a grain. A much stronger solution may be used, as the following:

℞.—Atropiæ sulphat., gr. i;
Aquæ destil., ʒi. M.

A minim of this represents one-sixtieth of a grain. Or the following may be preferred:

℞.—Atropiæ sulphat., gr. i;
Aquæ destil., ʒij. M.

A minim of this contains one-one-hundred-and-twentieth of a grain. I prefer the first solution for these reasons:

It is sometimes desirable to inject very minute quantities in susceptible subjects, and this cannot be done when the solution is very concentrated.

The dose may be much more varied in a weak solution.

I have elsewhere stated the general objections to strong solutions, which apply to atropia.

A *penicillum* develops very rapidly in an atropia solution, and at the expense of the atropia; the more concentrated the solution the greater the loss.

On account of the rapid growth of the *penicillum*, the solution of atropia should not be kept too long, but should be prepared in small quantity frequently during warm weather. Filtration will, of course, free the solution from visible impurities, but considerable loss of strength will be noticeable each time.

DOSE.—Extraordinary discrepancies are to be found in the statements of various authorities as to the quantity of atropia which may be used subcutaneously. Dr. Anstie* notes with surprise the large quantity advised by Trousseau,—$\frac{1}{12}$ to $\frac{1}{6}$ of a grain,—a quantity sufficient to produce most serious toxic symptoms. Dr. Ruppaner† gives the dose at $\frac{1}{60}$ to $\frac{1}{30}$ of a grain, Lorent‡ at $\frac{1}{25}$ of a grain, and Courty employed so much as $\frac{1}{6}$ of a grain at a single operation. Five minims of the solution which I recommend to the reader, or $\frac{1}{48}$ of a grain, is the largest amount desirable to use in most cases. Very

* The Practitioner, op. cit.

† Hypodermic Injections, op. cit.

‡ Die hypoder. Inject., l. c.

ordered in consequence of the vertigo and of the impairment of the muscular sensibility; objects appear confused, and distances cannot be correctly appreciated; hallucinations and illusions occur; when sleep takes place it is disturbed by vivid dreams, sometimes frightful, sometimes pleasing, the patient awaking and holding conversation with imaginary persons. Sometimes a somnambulistic state is produced, in which the patient walks about as if engaged in his usual avocations, talks with the objects of his visions, and quarrels and struggles with those who would oppose and restrain him.

Sometimes the face and forehead are of a vivid red hue, resembling in color the eruption of scarlatina; the fauces are also red and injected, and, to complete the resemblance to this eruptive fever, a whitish fur covers the tongue, through which the red and enlarged papillæ project.

The dryness of the mouth, after some hours, is replaced by a moist condition, in which a viscid, sticky, and somewhat odorous secretion makes its appearance. Corresponding to this change in the mucous membrane of the mouth, some increase in the peristaltic movements of the intestines is to be observed, the evacuations being somewhat loose.

Frequent desire to evacuate the bladder is now experienced, with diminished power, the emission of urine taking place slowly and with difficulty, and sometimes, indeed, only after repeated efforts does the flow occur.

The mental effects, generally such as I have described, are sometimes of a character to awaken grave anxiety. Great depression of mind, a melancholic state, with a suicidal tendency, at night horrible dreams and visions, leading to acts of violence, have been noted by me in some exceptional cases. I mention this so that the reader will ascertain what peculiar mental effects, if any, have followed the atropia injection, and avoid repeating it if the sensations above described have been experienced by the patient.

Such, in general, are the effects produced by the hypodermic injection of a full medicinal dose. These effects continue about twenty hours; the dilatation of the pupil, the disorders of vision, and the slowness and difficulty of micturition, being the last symptoms to disappear.

Atropia cannot be considered very actively toxic. The symptoms which it produces afford ample warning of danger before the life of the individual is really placed in jeopardy. The sensations which accompany the full manifestations of its physiological effects are so unpleasant that the patient early seeks relief, and the symptoms are so characteristic that a mistaken diagnosis is hardly possible.

When a fatal dose is received, all of the effects which I have described exist in an exaggerated degree. The pulse finally becomes small and thready, the action of the heart weak, and coldness of the surface succeeds to the unnatural warmth. This

change in the symptoms indicates that the "irritability" of the organic muscular fibre is exhausted.

In order to a thorough comprehension of its therapeutical action, we must form some exact notions of the mode in which these physiological effects are produced.*

The facts to be investigated are these:

The dilatation of the pupil.

The dryness of the mouth (arrest of secretion).

The increased action of the heart and lungs.

The rise of body-heat.

The influence on sensibility and motility.

Several opinions have prevailed as to the mechanism by which the dilatation of the pupil is accomplished.

This act, as well as the presbyopia, is now known to be produced through the influence of atropia on the organic muscular fibre. By contraction of the radiating fibres of the iris, which are innervated by the sympathetic, the pupil dilates; by a similar action on the muscle of accommodation, the lens is elongated, its diameter diminished, and the subject becomes presbyopic. It is probable, also, that this effect is facilitated by the paralyzing action of atropia on the oculo-motor nerve.

A number of experiments have been made to deter-

* I have examined this whole question in my Prize Essay of the American Medical Association for 1869, on Atropia, its Physiological Effects and Therapeutical Uses, to which the reader is referred for full information.

mine the character of the influence exerted by atropia upon the heart and lungs. The part that paralysis of the pneumogastric plays; the part that direct stimulation of the cardiac portion of the sympathetic takes, in the production of the phenomena, have been earnestly discussed. The inhibiting influence of the pneumogastric on the action of the heart is well understood: if the terminal filaments of this nerve are paralyzed the action of the heart increases. It has been found, however, by Lemattre,* that the action of the heart is increased by atropia, notwithstanding division of the pneumogastric: this agent must, therefore, exert an immediate stimulant action on the cardiac ganglia of the sympathetic. This same effect is witnessed on the organic muscular fibre of the arterioles, as demonstrated by Lemattre in the vessels of the frog's foot, and confirmed by myself. I have demonstrated another fact: the contraction of the vessels after a time ceases, and relaxation takes place. This change is coincident with a weakened action of the heart; in other words, the atropia finally exhausts the irritability of the organic muscular fibre. This is a capital fact, which must not be forgotten in our therapeutical employment of atropia.

The rise in body-heat is a product of increased oxidation due to the greater activity of the circulation. The redness of the skin and mucous membrane is due to the larger amount of blood pumped into

* Archives Générales, 1864.

the capillaries, and the increased arterial tension. The increased oxidation finds expression in a much greater excretion of urea and the urates.

There are several physiological facts which explain the action of atropia in arresting secretion of the pulmonary and intestinal mucous membrane. Prevost* has demonstrated that ablation of the spheno-palatine ganglion is followed by greatly increased secretion from the Schneiderian mucous membrane. The action which atropia exerts on the ganglia of the sympathetic must be the opposite of this.

Patients brought fully under the influence of atropia generally experience considerable disorder of voluntary movement. This effect is compounded of vertigo, diminished sensibility of the sensory nerves, loss of co-ordinating power, and paresis of the muscular system of animal life.

A very curious phenomenon was observed by Frazer† in frogs paralyzed by atropia many hours. When they lay limp and motionless, completely paralyzed, and apparently dead, it was found that cutaneous irritation immediately excited tetanic spasms. I had noted previously (Prize Essay) that during the combined action of atropia and physostigma these convulsant and tetanic spasms could be excited at once. This remarkable fact serves to show the close

* Archives de Physiologie Normale et Pathologique, vol. i.

† Previously Undescribed Tetanic Symptoms produced by Atropia in Cold-blooded Animals. From Transactions of the Royal Society of Edinburgh. Edinburgh, 1869.

relationship in action of those agents which belong to the two groups respectively of paralyzers and tetanizers.

THERAPY.—It will be convenient to arrange the subjects under this head in the same way as in the section on the therapeutical applications of morphia.

*Diseases of the Brain and Nervous System.*

**Cerebral Diseases.**—The subcutaneous injection of atropia is contraindicated in inflammatory affections of the brain and meninges, for a constant result of the toxic effect of this remedy is hyperæmia of these organs. I have seemed to produce some good results, and certainly have relieved the referred pains of the extremities, in cases of general paralysis. The "*late rigidity*" which comes on in many cases of hemiplegia, and which is often accompanied by severe pain in the affected limbs, has been much benefited by the hypodermic injection of atropia. The pains of *progressive locomotor ataxia,* and that annoying disturbance of the sensory nerves, "*the fidgets,*" which so constantly attends upon this disorder, may be relieved by this means. It has seemed to me that the subcutaneous injection of atropia exercised some influence, also, in retarding the progress of this disorder. Lorent has used the injection of atropia with advantage for relieving the pains which accompany *chronic meningitis* and *myelitis.* According to the views of Brown-Séquard, who holds that belladonna, by producing

contraction of the arterioles, diminishes the supply of blood to the cord, the hypodermic injection of atropia ought to be very serviceable in myelitis. But it is now known that the increased action of the heart, and the greater arterial tension produced by atropia, favor hyperæmia of these parts.

The hypodermic injection of atropia is serviceable in certain cases of *delirium tremens*. The indications for its use are these:

Obstinate insomnia, with great restlessness.

Weakened action of the heart; coldness of the surface; clammy sweat.

Failure of nutrients, bromide of potassium, chloral, and hypodermic injections of morphia, to quiet the delirium and induce sleep.

In similar conditions in the *psychical disorders* the subcutaneous injection of atropia is serviceable. This method of treating these disorders has the sanction of the eminent authority of Graefe. My own observation entitles me to insist on this caution: the use of atropia is unsuited to cases in which there is hyperæmia of the nervous centres, or in cases of excitement with power. Moreover, it is not suited to cases of melancholia, for the reason, already stated, that in many persons it produces great despondency of mind.

Certain cases of *mania*, characterized by restlessness, motor activity, and mental as well, with hallucinations and incoherent rambling, the physical state being that of weakness and relaxation, are sometimes

remarkably benefited by atropia. Ringer* describes such a case, and shows that atropia is nearly if not quite as useful as hyoscyamia has been in analogous cases.

In *puerperal mania*, the general system being in the condition of weakness and depression, atropia is often successful in securing sleep and improving the mental state.

Atropia cannot be considered a *hypnotic* in the true sense of that term. It is sometimes said to produce this effect indirectly; by allaying pain, it is believed to render sleep possible. This, in the opinion of the author, is not a correct statement of the ground of its utility in certain cases. It is sometimes very useful as a hypnotic in cases of wakefulness and coma-vigil, dependent upon cerebral anæmia.

**Neuralgia.**—The subcutaneous injection of atropia is not as effective in the treatment of the neuralgias in general as morphia by the same method. The systemic effects of atropia are also more unpleasant. For these reasons morphia is generally preferred. Nevertheless, when morphia fails to produce the desired result, or disagrees with the patient, as is sometimes the case, atropia may be used. In certain neuralgias, it must be admitted also, atropia is to be preferred to morphia, *e.g.*, in pelvic pain, in which Dr. Anstie considers it superior to morphia, in sciatica, and in certain cases of *tic douloureux*. In the pain of the

* The Practitioner, vol. xviii. p. 166

known, have the opposite effect on the reflex faculty. A number of cases have been reported cured. The daily use of $\frac{1}{120}$ grain subcutaneously is probably a suitable amount.

*Diseases of the Respiratory and Circulatory Organs.*

The subcutaneous injection of atropia is applicable to the treatment of certain neuroses of the thoracic viscera.

**Asthma.**—Courty was the first to employ atropia subcutaneously for the relief of asthma. He injected the solution over the pneumogastric nerve. Belladonna, in large doses, is now held to be the best remedy by Hyde Salter, Prof. Sée, and others.* Prof. Sée recommends belladonna because it is a "vascular and cardiac" agent, and "because the means of modifying respiration is to be found in the power to alter the pulmonary circulation." The hypodermic injection of atropia is preferable to the internal use of belladonna, for the following reasons:

The effect is more speedy and certain.

The relief which it affords is greater and more lasting.

In my experience cases of emphysema and spasmodic breathing, due to dilatation of the right cavities of the heart, are not so much benefited by atropia as asthma. I think it prudent to add a caution here: as atropia exhausts the irritability of the sympathetic ganglia, it

* The Practitioner, July, 1869.

is not proper to push the use of this agent in cases in which the muscular tissue of the heart is weakened by dilatation or fatty degeneration.

In order to procure the greatest relief to the asthmatic paroxysm, the injection should be made promptly at the beginning of the attack. The dose will vary from $\frac{1}{96}$ to $\frac{1}{48}$ of a grain. It may be inserted at any convenient situation. Succeeding attacks should be anticipated if possible, the injection being made when the first warnings are felt by the patient. As the effect of the atropine injection reaches its maximum in about a half-hour, it will at this time be perceived whether a sufficient quantity has been administered.

This method of administering belladonna is much to be preferred to the stomach administration, or to the methods of fumigation, pulverization, or inhalation, notwithstanding fumigation is strongly urged by Prof. Sée* in some lectures on the subject of asthma.

The administration of atropia may occasion much distress in the case of those asthmatics who suffer from dryness of the bronchial mucous membrane, and who experience relief when the secretion of mucus becomes abundant. I have known most alarming dyspnœa produced by the use of atropia in such subjects, and I therefore record a warning for the benefit of the inexperienced.

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* Bulletin Général de Thérapeutique, 15 Août, 1869.

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A number of cases have been reported cured.
daily use of $\frac{1}{120}$ grain subcutaneously is pro
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n this topic.

ses.—In *dysuria* and *enuresis* it is
tual. Belladonna has long had a de-
minence in the treatment of nocturnal
of urine. Atropia by subcutaneous
is the most effective way of administer-

*lation of the bladder*, when arising from a ner-
erythism, may be relieved in the same way.
a troublesome disorder, *spermatorrhœa*, is most
cessfully treated by the hypodermic injection of
tropia. Two indications are to be supplied in many
of these cases: the erotic sensations which originate
during the sleeping state are to be suppressed; the
reflex act of emission to be prevented. No agent

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...r the effects of atropia are quickly poisoned ...rdinary toxic dose of the acid.

Atropia is the antagonist to pilocarpine, muscarine, and physostigmine (eserine), and may be used to overcome and remove the lethal symptoms caused by either of these agents.

accomplishes this more successfully than th
neous injection of atropia at bedtime a
intervals as observation has shown to be

*Constitutional Diseases.*

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ment has been suggested by Harl
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In my prize essay
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following formula for powders will be found convenient:

℞.—Morphiæ sulphatis, ʒss;
Atropiæ sulphatis, gr. ss. M.
Ft. pulv. no. cxx.

Each powder contains $\frac{1}{8}$ of a grain of morphia and $\frac{1}{240}$ of a grain of atropia. One or two of these may be dissolved in clear water and administered according to necessity.

For reasons which will presently be stated, one-twenty-fourth of a grain of atropia is considered equivalent, in toxic power, to one grain of morphia.

The relative doses of these agents, when mixed, will depend upon the character of the case for which they are administered.

When the object is to relieve severe neuralgias which resist ordinary doses, the maximum quantity is required. By combining atropia with the morphia, we can inject a quantity of the latter agent which it would be very unsafe to use alone. Thus $\frac{1}{2}$ and even 1 grain of morphia and $\frac{1}{48}$ and $\frac{1}{24}$ of a grain of atropia may be injected together, relying for immunity against ill effects upon the antagonisms existing between them.

PHYSIOLOGICAL EFFECTS.—Although much has been said in the preceding pages upon the physiological effects of morphia and atropia, when separately administered, it is necessary now to show the influence which they reciprocally exert when administered together. Their so-called "physiological antago-

## IV.

### MORPHIA AND ATRO

So numerous and important
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The two agents are used to
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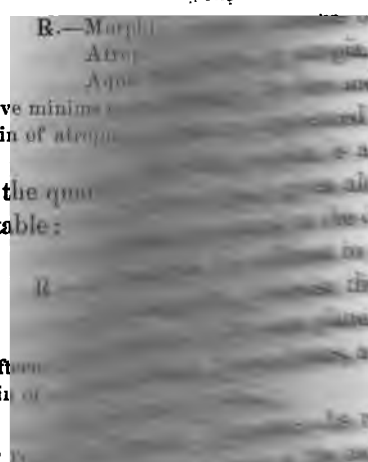
are the most suitable propor



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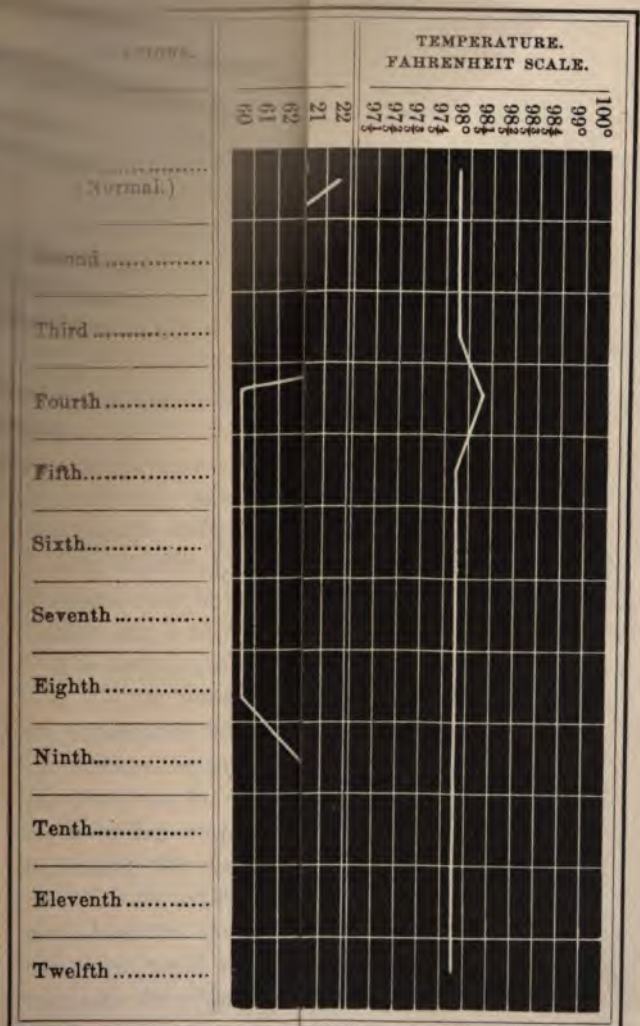

produce this state and exalt it when administered together. Morphia tends to produce constipation; atropia relaxes the bowels. When administered together, they produce almost immediately intestinal movements, frequently borborygmi, and sometimes sharp pain, and the bowels are kept in a soluble state. The sickness and nausea, and the not uncommon great depression of the vital powers caused by morphia, are opposed by atropia. These agents may therefore be given together in cases in which morphia cannot be borne alone. The after stomachal effects of morphia—indigestion, loss of appetite, a pasty tongue—are much diminished by the atropia, but are not absolutely prevented. Atropia itself is capable of producing these stomach disorders when used in considerable doses; hence, to produce the result which I have described, the proportion of morphia and atropia should be as follows:

Morphia, $\frac{1}{4}$ of a grain;

Atropia, $\frac{1}{120}$ of a grain.

4. *On the Genito-urinary Organs.*—These agents are antagonistic as to their effects on the kidneys and the urinary excretion. Morphia suspends, and atropia promotes, the functional activity of the kidneys. By inducing congestion of the Malpighian tufts, and increasing the *vis a tergo*, atropia acts as a diuretic, and with the additional water there strains off from the blood the larger amount of urates produced in the more rapid metamorphosis of tissue. Morphia increases the action of the sudoriparous glands, and

atropia diminishes it, thereby in the one case lowering, in the other case exalting, the functional activity of the kidneys.

Both produce dysuria, but this result comes of a different action in each case. Morphia impairs the contractile power of the muscular coat of the bladder, so that it contracts with difficulty, the emission of urine taking place slowly; atropia maintains steady tonic contraction of the sphincter, so that it dilates slowly under the voluntary effort, when the desire to micturate is experienced.

Morphia impairs but slightly, atropia to a considerable extent, the sexual appetite; both diminish the ejaculatory effort.

THERAPY.—It would be a waste of space to repeat the therapeutical applications of morphia and atropia already given with considerable fulness in the preceding sections. Nevertheless, it is necessary to indicate the circumstances requiring or permitting their conjoined administration. A general rule may be formulated as follows:

Whenever the hypodermic injection of morphia is proper and necessary, atropia should be combined with it, unless contraindicated.

In the *psychical disorders*, in which power is in excess, the conjunctivæ injected, the temperature high, morphia should be used alone. When power is deficient, the tendency being to depression, atropia should be combined with it. This is the rule, also,

for other *affections of the brain* in which the subcutaneous injection is indicated.

For the relief of *insomnia,* or to procure sleep, the combination of morphia and atropia is to be preferred. The reader should not forget that an excess of atropia, or an amount of atropia sufficient to antagonize the cerebral effects of the morphia, will prevent sleep. They should be used in the proportion of $\frac{1}{120}$ to $\frac{1}{96}$ grain of atropia to $\frac{1}{4}$ grain or $\frac{1}{2}$ grain of morphia. As the susceptibility to atropia varies immensely, the precise quantity to be employed in any case must be regulated accordingly.

In the treatment hypodermically of the *various convulsive disorders,* morphia and atropia should be combined.

The *neuralgias* are best treated by the combined morphia and atropia solution. There are several reasons for this:

Much larger doses of morphia may in this way be injected without danger to the patient; and the larger the quantity, as Brown-Séquard has shown, the greater the curative power.

Morphia and atropia combined are more effective than either singly.

The systemic effects during the time of maximum narcosis, and also after the narcosis has disappeared, are much less unpleasant and depressing when the two agents are combined than when morphia is used alone.

Sometimes atropia is better borne than morphia,

and *vice versa:* in this case the agent whose effects are least unpleasant should be in excess.

In *sciatica* atropia is often more effective than morphia: the proportions in which they should be used are as follows: $\frac{1}{48}$ to $\frac{1}{120}$ of a grain of atropia, $\frac{1}{4}$ to $\frac{1}{2}$ grain of morphia: here the physiological effects of atropia predominate, but the toxic effects are guarded by the morphia.

In *neuroses of the respiratory and circulatory organs* morphia and atropia should be used together. This is especially the case in *angina pectoris* and *asthma*, with the caution I have already given as to the use of atropia in certain diseases of the heart. Morphia alone is to be preferred in *pleuritis*.

In the *diseases of the digestive apparatus*, requiring hypodermic medication, morphia and atropia should be used together.

As a general rule, in *diseases of the urinary and genital organs*, the two agents should be combined. For some purposes atropia should be in excess, as in *spermatorrhœa*, when the more decided anaphrodisiac effect of this agent is indicated. In cases of *pelvic* and *uterine pain*, atropia should be proportionally in larger amount than morphia.

*Acute rheumatism*, *rheumatic gout*, *muscular rheumatism*, and *myalgia* are best relieved by a combination of morphia and atropia, the latter being in excess, as respects its physiological action, of the former. The injection of atropia, thus guarded by morphia, exerts in these diseases an action beyond

the relief of pain, how desirable, soever, that may be: it modifies, in a way not now understood, the morbid process. The progress of research renders it more and more probable that rheumatism is an expression of disorder in the nervous system, rather than an affection *per se* of the fibrous structures. Besides relieving in some way this centric disturbance, atropia favors the excretion from the blood of products (the urates) representing the active but imperfect tissue-change occurring in these diseases.

In surgical disorders of various kinds, the combined use of morphia and atropia has most important and varied applications: *to prevent and relieve shock; to cure pain; to relax spasm; to facilitate surgical operations.* Whenever, in surgical practice, the hypodermic injection of morphia and atropia is indicated, the following rule should regulate the relative proportion in which they are employed:

If the action of the heart be feeble, the surface cold, and the vital powers depressed, atropia should be in excess as respects the physiological effects.

TREATMENT OF TOXIC SYMPTOMS CAUSED BY MORPHIA OR ATROPIA.—I may assume, notwithstanding the objections of Harley and the results of experiments on animals by Brown-Séquard, that the physiological antagonism of morphia and atropia has been amply demonstrated by cases of poisoning occurring in man.

In treating cases, the difficulty of precisely regulating the amount necessary to overcome the toxic

symptoms is not easily surmountable. I ascertained, in the case which occurred to myself, that one-twenty-fourth of a grain of atropia was equal in toxic power to one grain of morphia. The state of the pupil affords valuable but not unerring indications; atropia possesses more power, relatively, over the movements of the iris than morphia.

In a case of morphia-poisoning, subcutaneous injections of atropia should produce the following results:

Dilatation of the pupil.

Flushing of the face succeeding to pallor.

Dryness and warmth of the skin succeeding to a cold and clammy sweat.

Rise in the pulse-rate and temperature.

Return of reflex movements of eyelids and fauces.

The dilatation of the pupil should be slightly maintained, and should not be carried to the exaggerated degree sometimes thought necessary. The mistake should not be made of confounding the sopor produced by morphia and atropia with morphia coma. This caution is the more necessary because this sleep is often considered a condition of danger requiring renewed administration of the antidote, and the patient is at length poisoned by atropia. Sufficient atropia should be administered to maintain the action of the heart and the respiration. So long as these continue good, no danger is to be apprehended from *sleep* merely.

Atropia, relatively considered, does not equal mor-

phia in toxic activity. Severe physiological effects do not necessarily imply a condition in which life is endangered. It is to be remembered that the toxic effects of atropia endure much longer than those of morphia, and hence repeated applications of the physiological antidote may be required.

## V.

### DUBOISIA.

DUBOISIA is the alkaloid of Duboisia Myoporoides, a member of the Solanaceæ.

THE SOLUTION.—The salts of the alkaloid, or active principle, are freely soluble in water, and hence the solutions for hypodermic use are readily prepared. The following formula will be found useful:

℞.—Duboisiæ muriat. vel sulph., gr. i;
Aquæ destil., ʒi. M.
Sig.—Eight minims contain $\frac{1}{60}$ of a grain.

THE DOSE.—The amount administered will depend on age, idiosyncrasies, habit, etc. For an adult the dose will range from $\frac{1}{100}$ to $\frac{1}{40}$ grain. Eight minims of the above-mentioned solution will produce characteristic physiological effects, but a much larger quantity can be administered without causing dangerous symptoms.

PHYSIOLOGICAL EFFECTS.—Dryness of the mouth and fauces, difficulty of deglutition, and a husky voice are experienced in a few minutes; simultaneously there is a sense of fulness in the head, tinnitus, and vertigo; the action of the heart is accelerated, the pulse gains in tension, the face flushes, the pupils dilate, and the vision for near objects is blurred and

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latter in hypodermic employment, if
to be obtained and the price will justify

PY.—Duboisia may be substituted for atro-
the conditions of disease in which the latter

is now employed. Duboisia is to be preferred, probably, in all cases; but recent experiences justify me in the expression of my conviction that it is much more effective in *psychical disorders* than atropia. The indications for the administration of these agents are the same.

## VI.

### STRYCHNIA.

THE SOLUTION.—A solution for hypodermic use may be prepared as follows:

℞.—Strychniæ sulphat., gr. i;
Aquæ destil., ʒi. M.

To obtain a perfect solution, heat in a test-tube until all the crystals disappear; or the crystals may be triturated in a mortar and the distilled water added gradually. Ten minims of this solution represent one-forty-eighth of a grain. Eulenberg proposes the following formula:

℞.—Strychniæ sulphat., gr. ij;
Aquæ destil., ʒij. M.

One minim of this contains one-sixtieth of a grain. The sulphate of strychnia, as found in the shops in this country, is not so soluble as this formula indicates. Solution in this proportion may be effected by the aid of heat, but on cooling the salt will be deposited. Even when it is dissolved in the proportion I have recommended (gr. i—ʒi), after a time crystals will slowly separate and adhere to the glass. For this reason, a solution long kept is unfit for use.

The solutions of strychnia, much less than the other

. w seconds pain or distention is felt in the
. intestinal movements and loud borborygmi
just as is the case so frequently after the hypo-
. injection of the narcotic alkaloids. Next the
pils dilate, deep-seated pain and throbbing are felt
n the brain, and an unpleasant giddiness renders the erect posture painful, and standing or walking uncertain. Ringing in the ears, detonation, anxiety, a feeling of dread, and flashes of light before the eyes are also quite commonly experienced. The countenance of the patient affords some indication of the cerebral disturbance, appearing anxious and distressed.

The foregoing symptoms are more severe if larger doses be administered, and in addition there occurs some stiffness of the jaws, jerking of the extensor muscles, and sharp pains like electric shocks shooting through the limbs. Dr. Echeverria has so well described the toxic symptoms that I transcribe his account. My own observations supply no further experiences than those I have just detailed.

"I injected first the right thigh, and about two minutes after, the left. In two minutes more the boy commenced to sigh, and have a meaningless smile, with stiffness in the jaws, soon passing into real trismus. The pupils were largely dilated, the face congested, and tetanic spasms of the respiratory and cervical muscles followed. Every attempt to articulate a word awoke a spasm. He could neither speak nor be touched without being seized with a

jerk, and the whole surface of the body was i
spiration."* In another case Dr. Echeve
similar experiences. He thus describes th
about eight minutes she complained of giddi
was soon seized with trismus and opisthoto
tetanic spasms were not violent, and were acc
by general perspiration, congestion of the
enlargement of the pupil." Other import
vations were made by Dr. Echeverria. "
perature of the limbs was always raised
injection. The frequency of the pulse
augmented. The capillary circulation wa
more active in the limbs, exhibiting large r
more intense in the vicinity of the punctu
This condition would last three and even
after the operation. The injections wer
with perspiration of the head and limbs,
fuse with the girl than with the boy.
were always dilated, and gurgling of
would persist some minutes after the
Another very perceptible result was
contractions, or twitching of the muscles i
lasting for a minute or two, and which I
prolonged for more than an hour in o
cases."

When we come to analyze the sympto

* Treatment of Paralysis by Hypodermi
Strychnine. Medical Communications of th
State Medical Society, 1868.

by the subcutaneous injection of strychnia, we perceive that the action is exerted chiefly on the nervous systems of animal and organic life.

Dr. Echeverria, from whose able paper I have just quoted, makes much of the effects on the organic nervous system, to support his peculiar views of the nature and causes of certain forms of paralysis. These effects are the following:

The dilatation of the pupil.

The intestinal movements.

The sweating.

The rise in temperature of the paralyzed parts into which the injection has been inserted.

There are no differences of opinion as to the action of strychnia on the nervous system of animal life; but the special seat of the action is much disputed. It would be of little service to occupy space with these different opinions; it will suffice to state that Schroeder Van Der Kolk has demonstrated conclusively that it acts on the medulla oblongata, the alterations of this organ consisting in a dilatation of its minute vessels. The morbid state of the reflex faculty is a product, then, of the altered nutrition of this part of the cord.

In addition to these remote effects of the injection consecutive to absorption, it is important to note certain local effects of a special kind, of great importance from the point of view of the therapeutical action of strychnia in paralytic affections. Dr. Echeverria has called attention to the "fibrillar contrac-

tions, or twitchings of the muscles in t
into which the strychnia injection has been t
have witnessed this very satisfactorily in th
some experiments with atropia and strych
taneously injected. If a mixed atropia and
injection be thrown under the skin of a c
tion of the pupil will quickly occur, follow
lent twitching of the muscles in the neig
of the injection, and thence propagated t
voluntary muscles.

THERAPY.—The hypodermic use of str
based upon the physiological action of tha
and I consider its therapeutical application fr
point of view.

**In Paralysis.**—Dr. Béhier, of Paris, ap
have been the first to employ the hypoderm
tion of strychnia for the cure of paralysis.
Courty afterward used it in three cases of
palsy, the patients completely recovering. Th
important contribution to our knowledge o
subject was made by Mr. Charles Hunter,
paper entitled "On Strychnia Hypodermical
ministered in Paralytic Affections."* The
of Dr. Echeverria, from which I have quot
also advanced our knowledge. In additi
these, a number of cases, occurring chiefly
practice of Dr. Hammond, of New York, hav

* British and Foreign Medico-Chirurg. Review, April, 1

reported by Dr. Reuben A. Vance.* These were cases of hemiplegia, paraplegia, and local paralysis. As might have been expected, the local paralyses were most decidedly benefited, but all were improved in a marked degree. The forms of paralysis which have been treated in this way are the following:

| | |
|---|---|
| Hemiplegia. | Infantile paralysis. |
| Paraplegia. | Local paralyses. |

Progressive muscular atrophy.

Progressive locomotor ataxia.

Mr. Hunter reports three out of four cases of *hemiplegia* cured by the injections of strychnia. Two of the cases were respectively of six and two and a half years' duration. This statistical statement should not mislead the reader. Success like this cannot be expected in the treatment of paralysis of cerebral origin; the cases of Mr. Hunter were evidently very favorable cases for treatment by this method. Nevertheless, the hypodermic injection of strychnia, in many cases, is decidedly curative. As Dr. Echeverria has well remarked, "the effects of strychnia are widely different when administered hypodermically or by the mouth. By the latter method the quantity may be repeated and increased, unsuccessfully, as manifested in the cases of Hunter, and in those here related; and yet

* Journal of Psychological Medicine, vol. iv. p. 367, et seq.

a smaller dose of the substance, exhibited hypodermically, be capable of regenerating at once the lost muscular power."

We should possess clear notions, then, as to the circumstances in which it may be proper to use the hypodermic injection of strychnia in hemiplegia, for, manifestly, a remedy of such power may prove to be as harmful when indiscreetly employed as it is unquestionably useful in suitable cases.

It is contraindicated in recent hemiplegia.

In my own experience it has not been useful in old cases characterized by contractions of the palsied limbs, for this condition signifies, according to Todd, who styles it "late rigidity," an irritative action about the site of the extravasation.

It has been exceedingly useful in old cases of hemiplegia in subjects not very advanced in life, the paralysis being partial as to motility, and the limbs not wasted.

The hypodermic injection of strychnia has been used in *spinal paraplegia* by Béhier, Courty, Ruppaner, Hunter, Echeverria, and others, with success. The rules for its administration are similar to those I have given for hemiplegia.

It is not proper in acute cases involving structural alterations of the spinal cord.

In cases of paraplegia due to softening or tumor in the spinal canal it will do harm.

It will be beneficial in cases of reflex paraplegia, in paraplegia due to anæmia of the cord, in hysteri-

cal paraplegia, and in those cases of paresis of the muscles of the inferior extremities due to the concussion of the cord, but after the acute symptoms have subsided.

It is certainly true, however, that Mr. Hunter obtained advantage from it in a case the symptoms of which indicated myelitis. Dr. Echeverria's Case I. may be classed in the same category,—the patient complaining of formication and numbness, and being paralyzed both as to motion and sensation.

The hypodermic injection of strychnia has proved an exceedingly valuable adjunct to the treatment of *infantile paralysis.* If the electro-muscular contractility to the continuous or induced current be not lost, very beneficial results may be expected from this treatment. The injection promotes the capillary circulation, and increases the growth and power of the muscles.

In various *local paralyses* the hypodermic injection of strychnia is even more decidedly curative. Courty* cured *facial paralysis* by injecting strychnia over the course of the facial nerve. Pletzer, Lorent, Sacmann, and Eulenberg had good results from the same treatment.† In a case of paralysis of the vocal cords with aphonia, Neudörfer failed, but in a similar case Waldenburg succeeded with the strychnia injection.

In the "drop wrist" of lead-poisoning—*paralysis*

* Eulenberg, p. 243. † Ibid.

*of the extensors*—it is a very important addition to the other means of treatment of this very obstinate affection. It is more successful than any other agent in *writer's cramp*. Palsy of single muscles or groups of muscles, following cold or rheumatism, is generally curable by this means. The injection also increases much the contractile power in cases of palsy following injury of nerve trunks.

*Paralysis of the bladder*, with dribbling of urine, and *paralysis of the sphincter ani* not due to myelitis, are much benefited and frequently cured by this means.

In *progressive muscular atrophy* it has been used with great advantage in cases in which the electro-muscular contractility was not lost.

In paralysis of cerebral or spinal origin, without wasting of the muscles, the injection may be made under the skin. The dose of strychnia will vary, with the age of the subject, from $\frac{1}{60}$ to $\frac{1}{10}$ of a grain. In local paralyses, in infantile paralysis, in progressive muscular atrophy, the injection must be made into the affected muscles. If the electro-contractility be not lost, the following effects may be expected:

Rise in temperature of the limb, and increase of capillary circulation.

Increase in muscular power with growth of muscles.

Cure of the paralysis.

If, however, the electro-muscular contractility is

lost, fatty degeneration has so far proceeded that the injection of strychnia will be useless.

The method of practising the injection into the muscles is as follows:

The affected muscle or group of muscles is grasped with the left hand and made prominent, and with the right the needle is plunged quickly and boldly into the muscular tissue. When inserted as far as necessary, the needle is withdrawn a short distance to clear any vessel it may have penetrated, at the same time moving the point about, and then the fluid is slowly injected. It is important, of course, to avoid the blood-vessels, and to insert the needle into the paralyzed muscles. The pain of this operation is not greater than the subcutaneous injection, and little danger of deep-seated abscess is to be feared. Muscular tissue, as is well known, does not readily take on the morbid action called inflammatory.

The systemic effects do not follow so quickly nor are they as powerful after injection into the muscular tissue as after the subcutaneous injection. Both local and systemic effects are produced; but it is chiefly the local effects which are desired in cases of local paralysis. Some cases of local paralysis of the bladder cannot be reached in this way. In paralysis of the sphincter ani the needle may readily be thrust into this muscle.

The subcutaneous injection of strychnia has been used in *progressive locomotor ataxia*, but with a nega-

tive result. In my own exp
no decided influence for g

**Neuralgia.**—The hypo
nia has been used by Dr. A
*cardiac neuralgia*, with a
opinion is, at present," says
is no such remedy for gastr
taneously injected in doses of
Although I cannot speak s
on this subject, I can say th
effects from the strychnia i
cases to which he refers.

**Amaurosis and Amblyopia.**—
berg, Fremineau was the firs
dermic injection of strychnia
of amaurosis following typhus.
reported a cure of amaurosis
Spaeth one of amblyopia,—"
the retina." Dr. Lacerda,*
the hypodermic injection of
in a case of "amaurotic at
Tiffis,† also succeeded in cur
peated injections, ranging in
of a grain. The most impo
our knowledge of this subject
Prof. Nagel, of Freiburg, wh

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blyopia and amaurosis, and even cases of the latter in which there was white atrophy of the optic disks.*

Weinow† employs the nitrate, $\frac{1}{50}$ grain, injected into the temple every two or four days. If no improvement occur after three injections, he discontinues the practice. In an excellent paper on the subject, Bull‡ gives a *résumé* of Nagel's observations, and follows with an account of twenty-four cases. He concludes that in functional amblyopia we may expect good and permanent results from strychnia; and even in some cases of organic origin, provided there be no extensive atrophy of the nerve structures, some improvement is obtained from the use of the remedy. If actual atrophy of the nerve exists, he thinks strychnia useless. All authorities are agreed that it is in alcohol and tobacco amaurosis, especially the latter, that the injection of strychnia renders such important service. It is conceded that the remedy will do no good if no improvement has occurred after three or four injections.

**As a Tonic.**—I have used the subcutaneous injection of strychnia to overcome the depression caused by the withdrawal of morphia. It has also given

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* Berliner klinische Wochenschrift, viii. p. 6, 1871. Also, Dr. Nagel's special treatise, which, however, I have not had the opportunity to consult.

† Quoted in the London Medical Record, vol. i. p. 156.

‡ The American Journal of the Medical Sciences, 1872.

## VII.

### CONIA.

THE SOLUTION AND DOSE.—The formula of Eulenberg is as follows:

℞.—Coniæ, gr. ss;
Spiriti, ʒss;
Aquæ dest., ʒiss. M.

Five minims of this represent one-forty-eighth of a grain. In preparing this solution, the conia should be first dissolved in the spirit, as it is insoluble in water. It is volatile, and exceedingly liable to decomposition, being converted into ammonia and a resin. For these reasons the solution should be prepared for use when required.

The dose will range from $\frac{1}{120}$ to $\frac{1}{60}$ of a grain: 2 to 4 minims of the solution above given.

PHYSIOLOGICAL EFFECTS.—The local effects of the injection are the same as those of other alkaloids. In the largest dose which can be safely administered, it induces sleepiness, vertigo, coldness of the surface, diminished sensibility, and weakness of the inferior extremities. The respiration becomes slower, and less full. The pulse diminishes in number and force, falling so much as thirty to forty beats per minute.

In a case of poisoning carefully observed by Dr.

Bennett,* weakness of the legs, and staggering were first noticed. Loss of all power of voluntary movement next followed. He became unable to swallow, and completely lost his power of vision. "His pulse and breathing were perfectly natural," but at the expiration of a half-hour after this, paralysis of the muscles of respiration had taken place, the action of the heart continuing but was "very feeble." Meantime his intelligence was preserved, but he was without power of articulation.

The mode in which conia produces these effects has been elaborately examined by Kölliker and Guttman. The last-named observer has shown that conia does not act on the spinal cord, nor does it destroy the irritability of muscle, but paralyzes the peripheral terminations of the motor nerves. Death is produced by asphyxia—paralysis of the muscles of respiration—and not by cessation of the heart's movements, for these continue after respiration has ceased.

THERAPY. — The therapeutical applications of conia by the hypodermic method are neither numerous nor important.

It has been used in the treatment of *asthma* by Pletzer. Although it appears to be a rational remedy, paralyzes the muscles of respiration, and in this way may be supposed to antagonize that condition of things which exists in asthma, experience is not

* Clinical Medicine, p. 413, Am. ed.

in its favor, and a careful examination of its physiological effects discloses the fact that the influence which it exerts on respiration is a toxic action only. In the treatment of asthma it is not at all equal to morphia and atropia; nevertheless, in cases in which these agents disagree, or in which it is undesirable to use them, it may be tried.

Erlenmeyer procured relief, by the hypodermic injection of conia, to the difficult breathing of *emphysema*. The same authority reports having cured a case of *angina pectoris* by two injections of conia. He therefore recommends it in these affections.

Lorent, influenced by theoretical considerations,—the action of conia on the pulse and respiration,—has employed this agent hypodermically in pneumonia and pleuritis, with the effect to reduce decidedly the pulse-rate. It does not appear that this treatment is worthy of serious consideration. In the spasmodic affections of the thoracic viscera, Lorent has had experiences with conia similar to those of Erlenmeyer.

Conia is also one of the numerous remedies proposed for the cure of *tetanus*. Successful cases have been reported, cured by conium administered internally; but we may be permitted to distrust these, since Harley has shown that the extract is entirely devoid of conia, and therefore innocuous. For the treatment of tetanus, the hypodermic injection of conia may be used with a reasonable expectation of benefiting the patient.

As conia produces motor paralysis, it has been held to be *antagonistic to strychnia;* but since it has been shown by Guttman that conia paralyzes the peripheral terminations of the motor nerves, and does not act upon the cord, this view must be abandoned.

## VIII.

### WOORARA OR CURARA.

THE SOLUTION.—The strength of the solution usually employed for hypodermic use is one per centum,—one grain to one hundred minims of water. The dose is $\frac{1}{10}$ of a grain, or ten minims of the solution. The repetition of the dose will depend on the effects produced, and on the character of the malady for which it is prescribed.

The active principle—woorarin or curarin—may be employed in place of woorara. In the form of sulphate it is readily soluble in water. The dose is $\frac{1}{200}$ to $\frac{1}{100}$ grain. The solutions should be carefully filtered, especially those of the crude drug, as it contains a great many impurities.

PHYSIOLOGICAL ACTIONS.—The actions of woorara have been investigated in the most thorough manner by Bernard, Kölliker, Kühne, and others. It is a necessary part of the equipment of a physiological laboratory since Bernard* made his historical observations on its action.

Woorara is locally an irritant. If the solutions are carefully prepared, no little pain and smarting

* Leçons sur la Physiologie et Pathologie du Système Nerveux. Tome i. p. 196.

are felt at the point where the injection is made,—inflammation follows, an abscess forms, and an ulcer remains. This is not an invariable, but a very frequent result, and should be mentioned, before the injections are practised.

Applied to the unbroken skin or mucous membrane no effect follows. Introduced into the stomach it rarely produces any toxic symptoms, although it is probable slow absorption may take place, and ultimately characteristic effects appear. Applied to a denuded surface, or subcutaneously, diffusion into the blood is rapid. It is a paralyzer of the nervous system of animal life. An early symptom is disturbance of vision, strabismus, double vision, ptosis,—the upper eyelids falling well over the eyes. Next, weakness of the lower extremities (paresis) comes on, extending ultimately to all the voluntary muscles. Death ensues from paralysis of the respiratory function. The paralyzing action of woorara is not in the muscles, for they retain their Hallerian irritability, but in the terminations of the nerves in the muscles,—the end-organs of the motor nerves. It is this complete paralyzing action, involving the nerves only, and leaving the muscles intact, that renders woorara such an important agent in physiological research.

The careful experiments of Hammond and Mitchell* on two varieties of woorara—*carroval* and *vao*

* The American Journal of the Medical Sciences, July, 1859.

—throw some important light on the subject of the action of woorara. The two varieties were similar in mode and character of action, but differed in power, —vao being much feebler. In their experiments, death was caused by paralysis of the heart, its muscular tissue having lost contractility.

According to the observations of MM. Voisin and Lionville,* when woorara is injected subcutaneously a state of shivering and feverishness, trembling, a rapid and weak pulse, sweating, quickly follow. In a few minutes the paralysis begins, and extends to all the voluntary system. If pressure by a ligature is made above the point where the poison is inserted, its entrance into the general mass of the blood is impeded. If artificial respiration is maintained in animals, death may be averted, even when a lethal dose has been given, so rapidly is it eliminated by the urine, which, indeed, may be actively poisonous. Distinct traces of sugar are also found in the urine, whence the condition is entitled "curara diabetes."†

THERAPY.—When the first publications were made, setting forth its peculiar action, very confident hopes were entertained that a specific for *tetanus* had been discovered. It failed in the hands of Follin, Gintrac, Cornoz, and Richard, and was successful in

* Archives Général de Médecine, Oct. 1866.

† L. Hermann, Lehrbuch der experimentallen Toxicologie. Berlin, 1874, p. 305.

the hands of Gherini, Demme, Lochner, and Spencer Wells.* In most of the successful cases it was used endermically as well as hypodermically. Of twelve cases treated by the hypodermic injection, four terminated favorably. According to the statistics of Demme, of twenty-two cases treated by woorara, administered in either mode, eight recovered. Prof. Busch treated eleven cases of tetanus by woorara, and six recovered; but, as the professor thinks this agent is adapted only to the more chronic cases, our estimate of its value must not be too high, for chronic cases often terminate in recovery under the most diverse methods of treatment.

In the successful cases, large doses of woorara were administered. Spencer Wells injected one-twelfth of a grain at a dose. The dose ranges from one-sixtieth to one-thirtieth of a grain. The frequency of administration will be governed by the effects upon the spasms.

Woorara has also been used in *strychnia-poisoning*, but without sufficient success to justify its employment in this class of cases. It does not bear the relation of a physiological antagonist to strychnia, and hence should not be used against the toxic symptoms caused by this agent.

Although the reports are contradictory in respect to the utility of woorara in *epilepsy*, it yet deserves a more careful trial than has been accorded it hitherto.

* Eulenberg, op. cit.

Kunze* also cites its use, and reports that in many cases marked improvement followed its administration. He practised the injections once a week.

Dr. Wise† reports a case, which he diagnosticated hydrophobia, an opinion in which Prof. Flint concurred, in which recovery ensued after the hypodermic injection of curara. The first dose was $\frac{1}{16}$ grain, and subsequently $\frac{1}{8}$ grain and $\frac{1}{4}$ grain were injected. The details of the case are well and accurately told, and the conclusion seems entirely justified.

Very recently an Italian case of hydrophobia has been reported cured by curara. Injections of morphia and inhalations of chloroform had been used without success. Then curara was used until paralytic symptoms occurred, when it was suspended. Then the symptoms of hydrophobia occurring, curara was used again with like success.‡

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* Deutsche Zeitschrift für prakt. Med., 1877, No. 1.

† Am. Journ. of Med. Sciences, July, 1876.

‡ La France Médicale, Aug. 1879, p. 541. From *Il dente*.

## IX

### NICOTIA.

THE SOLUTION AND DOSE.—Erlenmeyer recommends the following formula:*

℞.—Nicotiæ, gr. ss;
Aquæ destil., ʒij. M.

Four drops (minims) of this contain one-sixtieth of a grain,—a suitable dose.

PHYSIOLOGICAL EFFECTS.—Nicotia is one of the most deadly poisons, ranking in this respect with prussic acid. In its local action it is somewhat irritant. In its remote or systemic action it strongly depresses the nervous and vascular systems. At first respiration is slightly accelerated, and is accompanied by a bruit, produced, according to Bernard, by a very abrupt contraction of the diaphragm. Slowness and feebleness of respiration soon succeed to this acceleration. The pupils dilate, and convulsive phenomena make their appearance in the eyes and extremities, partly of a clonic, and partly of a tonic or tetanic character. Complete adynamia supervenes, accompanied by muscular trembling; the action of the heart becomes exceedingly feeble, and death takes

* Die subcutanen Injectionen, op. cit., p. 85.

place by failure of the circulation (paralysis of the heart).*

THERAPY.—Nicotia has been employed with success in the treatment of *tetanus*. About one-half of the traumatic cases treated with it get well,—a proportion of recoveries greater than with any other remedy except physostigma.

Prof. Houghton, of Dublin, who was probably the first to employ this agent in tetanus, ascertained experimentally that it is a physiological antagonist to strychnia.

Nicotia is indicated in *spasmodic asthma*, certain cases of *angina pectoris*, *colic*, *strangulated hernia*, etc., but I know of no instance in which it has been used for the relief of these conditions.

Cases of obstinate *convulsive tic*, "*histrionic spasm*," and local *muscular spasm* are of a nature, theoretically speaking, to be benefited by the subcutaneous injection of nicotia.

* Gubler, Commentaires du Codex Méd., op. cit., p. [illegible]

## X.

### HYDROCYANIC ACID.

THE SOLUTION AND DOSE.—The *Acidum Hydrocyanicum Dilutum* of the U. S. Pharmacopœia is the preparation which I have employed for hypodermic use. The maximum quantity which I have used is four minims, but this amount is hardly safe in many cases. It should not be forgotten that the action of hydrocyanic acid is so rapid that a toxic dose introduced under the skin would infallibly destroy life before any measures could be employed for relief. For ordinary purposes, two minims of the officinal solution will be sufficient for hypodermic use. As its effects are quickly expended, it may be repeated frequently—as often as every two hours.

PHYSIOLOGICAL EFFECTS.—Locally, the effects are somewhat irritant, but are not more so than a solution of morphia. A metallic taste, slight salivation, faint nausea, giddiness, and sighing respiration are the only systemic effects which I have observed from the doses I ventured to administer.

THERAPY.—The good effects sometimes produced in *mental disorders* by prussic acid, when administered by the stomach, are more conspicuously exhib-

ited when the remedy is injected under the ski
It is adapted to acute cases, in which power is in
cess. Cases of mania or melancholia, in which
subcutaneous injection of morphia proves hur
are benefited by prussic acid, and *vice versa*.

I have used hydrocyanic acid hypodermic
spasmodic asthma, but without moderating the
ysms. It is indicated in *angina pectoris*, and
cardiac neuroses, but I am not aware of any ins
in which it has been tried.

As a remedy for *gastralgia* when a simple
of the stomach, it is undoubtedly useful. In
and *vomiting* due to functional disturbance
pecially those cases in which morphia and
disagree, it may be used with a confident ex
of affording relief. But, as a general pr
subcutaneous injection of prussic acid in
ach disorders is, in respect to promptne
ciency, greatly inferior to morphia and at

The injection may be practised over
trium in cases of vomiting.

W. Preyer,† who has carefully investi
physiological action of prussic acid,
atropia is a physiological antidote. His
have conducted him to the conclusions t
acid acts by depriving the blood of its ox
that in very large doses it paralyzes the

* McLeod, Medical Times and Gazette, March
† The Practitioner, vol. i. p. 106.

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. Band 35, p. 291.

## XI.

### PHYSOSTIGMA—ESERINE.

THE SOLUTION.—The extract of physostigm formerly the only preparation available for hy mic use. Recently, the active principle—the loid *eserine*—has been substituted. The exist two alkaloids possessed of different properties to be established, but that which is known as is now universally employed in place of the drug and its preparations. The muriate or chlorate is the salt generally used.

℞.—Eserine muriat.. gr. iv;
Aquæ destil.. ℥i. M.
S.—Two minims contain $\frac{1}{60}$ of a grain.

Eserine is now also added to disks of gel. proper proportion. One may be dissolved i when required for use.

The dose of the alkaloid ranges from $\frac{1}{60}$ $\frac{1}{10}$ grain.

The extract may also be used hypodermi is simply rubbed up with distilled water a filtered. From one-fourth to one-half a gra ordinary dose of the extract, but in tetanus larger quantity can be injected. It is highl

tant to obtain a genuine preparation, otherwise disappointment must ensue.

PHYSIOLOGICAL EFFECTS.—The effects of physostigma and eserine are the same, in what mode soever they may be administered, but they are more rapid and pronounced by the subcutaneous areolar tissue. When a full dose is administered, giddiness, a sense of weakness and fatigue, and difficulty in maintaining the vertical position and in walking are experienced. The action of the heart and the arterial tension are lowered for a brief period at first, but in a short time the tension rises, and the heart-beats become more vigorous. Toxic doses in man cause death by paralysis of respiration and of the heart, the whole muscular system, including the sphincters, being in a state of complete muscular relaxation, but the consciousness is preserved until carbonic acid poisoning clouds the mind. It is a paralyzer, but before complete resolution occurs, the voluntary muscular system is agitated by tremors, which consist in alternate muscular contraction and relaxation. The contractility of the muscles is not destroyed, not even impaired.* The peripheral nerves (end organs) and the trunks of the nerves are not concerned in the paralysis, but it is spinal entirely. Physostigma heightens rather than im-

* Fraser; from Transactions of the Royal Society of Edinburgh. W. Laschkewich, Virchow's Archiv, Band 35, p. 291.

pairs the sensibility of the sensory nerves. After merely lethal doses have been administered, the action of the heart continues after respiration; but, as already stated, large, toxic doses paralyze the heart in the diastole, and this organ is found after death flaccid, not at all or very feebly responding to galvanic excitation.*

Contraction of the pupil is a constant result of the action of physostigma, whether instilled into the eye or introduced into the general system. This result is doubtless due to paralysis of the sympathetic fibres and to stimulation of the third nerve.

As respects the intestinal canal, the effects of physostigma are not very distinctive. It increases secretion somewhat, and therefore the number and density of the alvine discharges.

THERAPY.—The applications of physostigma in the treatment of disease are directly deducible from its physiological action. Its principal effect being on the cord, destroying its reflex function, obviously it is adapted to the treatment of conditions in which the reflex function is abnormally excited, as in *tetanus*, *hydrophobia*, *strychnia-poisoning*, etc. A great many cases of tetanus have been treated, chiefly by the extract, and the average proportion of recoveries to death is one-half. The result in many

* Arnstein u. Sustschinsky, Abstract in Schmidt's Jahrbücher, vol. cxlii. p. 286.

and in checking the
erpuscles. To effect
ine is used chiefly by

referred to admits that this antagonism exists to a "slight extent," but is "more limited than even Dr. Fraser has indicated." This committee has also shown that "chloral hydrate modifies to a great extent the action of a fatal dose of Calabar bean (physostigma), and in some instances saves life from a fatal dose."

The use of physostigma in *epilepsy* and *chorea*, based on theoretical grounds, has not been satisfactory. In *progressive paralysis of the insane* the results obtained by Browne, although discredited by Williams, justify further trials by the subcutaneous injection of eserine. Agents acting decidedly as paralyzers of the respiratory function, as conium, gelsemium, lobelia, etc., have long been known to act favorably in *bronchitis*, *pulmonary congestion*, and *pneumonia*, and to them must now be added physostigma, which is reported to have good effects in these diseases.

Next to the use of eserine in tetanus, its most important applications in the treatment of disease are in the field of ophthalmic practice. It is now largely used to counterbalance the effects of atropia on the pupil; in iritis to break away or prevent the formation of adhesions; in ulceration and suppuration of the cornea; after extraction of cataract to prevent suppuration, and in the operation of iridectomy. The curative influence of eserine in these cases is due to its action in lowering the intraocular tension, in diminishing the conjunctival secretions by

contracting the blood-vessels, and in checking the migration of the white blood-corpuscles.* To effect these important purposes, eserine is used chiefly by the subcutaneous areolar tissue.

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* Weeker on Eserine, Pilocarpine, and Atropine in Ophthalmic Diseases, Bull. Gén. Thérap.

## XII.

### PILOCARPINE.

PILOCARPINE is the active principle of Pilocarpus pinnatus,—a member of the Rutaceæ,—commonly known as *Jaborandi.*

THE SOLUTION.—The alkaloid is freely soluble in water. The nitrate is the salt usually found in the market, but the sulphate, acetate, phosphate, chlorhydrate, and bromhydrate have been prepared.

℞.—Pilocarpin. nitratis, gr. xvi;
Aquæ destillat., ℥i. M.
S.—Five minims contain $\frac{1}{6}$ of a grain.

As pilocarpine is expensive, and the solutions spoil in a short time, a small quantity may be readily prepared, when required, in the proportions of the above formula.

THE DOSE.—Children are proportionally less susceptible to the action of pilocarpine than adults. Hypodermically, the dose ranges from $\frac{1}{6}$ of a grain to $\frac{1}{2}$ grain. Rarely is it necessary to exceed $\frac{1}{4}$ of a grain.

PHYSIOLOGICAL EFFECTS.—Within a few minutes (2 or 3) after the injection a subjective sense of heat, accompanied by a feeling of fulness of the

head, is experienced, followed speedily by a flush extending over the face, forehead, ears, and neck. Simultaneously the action of the heart increases, but there occurs at the same time a general fall of the blood-pressure. The most characteristic effect is the increase of the perspiration and the secretion of the salivary glands. As the flushing of the face takes place the saliva begins to flow plentifully, a profuse perspiration breaks out over the whole surface of the body, the nasal and bronchial mucus and the tears are also increased, and sometimes a profuse watery diarrhœa occurs. The amount of perspiration discharged from the skin is enormous, and the salivary flow is measured by pints. It sometimes happens that the amount of saliva is immense and the perspiration small, and *vice versa*, but usually both secretions are very greatly increased. A distinct fall of temperature—from 0.5°–2° Fahr.—takes place when the sweating occurs, and is maintained for about four hours. Pallor of the face succeeds to the flushing, the pulse becomes weak, drowsiness, an extreme degree of languor, and chilliness of the surface* are experienced. These effects of pilocarpine are due to the action of this agent on the vaso-motor nervous system.† Paresis of this system causes dilatation of the arterioles, increased afflux of blood to them, whence the flushing and the

* Albert Robin, Étude Physiologique et Thérap. sur la Jaborandi. Journ. de Thérap. for 7 nos., 1875.

† Kahler u. Soyka, Kymographische Untersuchungen über Jaborandi, Cent. f. med. Wissenschaft., 31, 541.

increased action of the heart. The sphygmographic and kymographic tracings show a considerable lowering of the vascular tension, and to this diminution of the vaso-motor tonus is the increased secretion of saliva and sweat due,—for Prevost has demonstrated that ablation of the spheno-palatine ganglion is followed by an enormous effusion from the Schneiderian mucous membrane. The reduction of temperature is referable to the discharge of fluid from the salivary glands and skin, the evaporation from the surface cooling the adjacent tissues, and a portion of the heat of the body converted into another mode of motion.

Pilocarpine contracts the pupil, and the accommodation is impaired. In the language of Mr. Tweedy,* when pilocarpine is instilled into the eye it causes "contraction of the pupil, tension of the accommodative apparatus of the eye, with approximation to the nearest and farthest points of vision, and amblyopic impairment of vision from diminished sensibility of the retina."

In consequence of the great loss of fluid by the skin the urinary secretion is diminished in amount, and, as more or less urea and salts are contained in the sweat, the urine is pale and watery. The bladder is irritable, and pain is felt along the urethra during the action of the pilocarpine.

THERAPY.—In *mumps* and acute affections of the parotid, submaxillary, and sublingual glands, and in

* Lancet, 11, 1875.

*acute tonsillitis*, jaborandi has been used with success.* When the *metastasis of mumps* takes place it is said to afford great relief. Obstinate *hiccough*, which had resisted ordinary means, yielded to pilocarpine hypodermically. *Hoarseness* (acute catarrh of larynx), *bronchitis*, *bronchorrhœa*, are cured or relieved by this agent. The *asthmatic paroxysm* has been promptly arrested by the hypodermic injection of pilocarpine. The paroxysms of difficult breathing accompanying emphysema are often quickly relieved by the same agent. In cardiac dropsy it is often beneficial by removing the surplus fluid. It is more especially adapted to the dropsy of acute albuminuria, and in the treatment of eclampsia, but the warning given us by Barker ought to be heeded. In all cases of disease in which there is a weak heart, pilocarpine must be used with caution, if at all. A further caution is necessary in respect to pregnancy, but it is doubtful if it possesses any real abortifacient property.

It is especially serviceable in the case of effusion into cavities and to effect the removal of recent products of inflammation. The good effects are conspicuous in the case of inflammatory effusions into the eyes.

The very important observation has recently been

* Besides the references already mentioned, the following should be consulted: Ringer and Gould, Lancet, 1875; Ringer and Murrell, British Med. Jour., 1875; Hardy et Rochefontaine, Gaz. Méd. de Paris, 25, 1875; De l'Action des Alkaloïdes du Jaborandi sur les Sécrétions des Glandes; Carville, Ibid., i. p. 9; Rosenbach, Berl. klin. Woch., 23, p. 315.

made,* that the hypodermic use of pilocarpine has the power to abort an impending *ague chill.* If given at chill time, just at or near the paroxysm, the sweat is induced and no febrile stage occurs. It appears further that in a considerable proportion of cases, the paroxysms are suspended permanently. Further experience is necessary to determine the actual value of this new expedient, but if it accomplish no more than abort single paroxysms of ague, it is a valuable addition to our resources. If a paroxysm has been prevented, but recurrences take place in the multiples of the regular periods (so-called septenary periods), it seems important to administer the pilocarpine in anticipation of, and without waiting for, such periods.

* Medical Record, August 16, 1879. Dr. Caspar Griswold, House Physician to Bellevue Hospital.

## XIII.

### CHLOROFORM.

THE injection of chloroform is not practised by the ordinary subcutaneous method, for the action is local and not systemic. It is not, therefore, adapted to the treatment of internal maladies, and is only useful in external neuralgiæ so situated that the injected chloroform may act on the nerve-trunk or on the peripheral distribution of the nerve. I have therefore entitled the method the "Deep Injection of Chloroform," in the articles I have written calling attention to the efficiency of this plan in the class of cases to which it is adapted.*

The needle is inserted deeply, in the case of the infra-orbital division of the fifth, underneath the lip, passing up so that its point is in the neighborhood of the nerve at its point of emergence; in the case of the sciatic, passed down near the trunk of the nerve at its exit from the pelvis. In the case of any superficial neuralgia the same plan is pursued,—the needle inserted deeply, so that its point rests in the neighborhood of the affected nerve. I am the more disposed to reiterate this instruction because it is too often supposed that the treatment consists in the sub-

*The Clinic, 1873, vol. v. p. 145; The Practitioner (London), 1874, vol. xiii. p. 9.

cutaneous injection of chloroform. This practice was long ago condemned or regarded as improper, owing to the violent local inflammation which follows its introduction into the subcutaneous areolar tissue. Thus, Dr. Anstie,* in an article on the "Hypodermic Injection of Remedies," says of chloroform, that it is "an agent entirely unfit to be used in that way." Hunter,* after some trials with it, had made a similar declaration: "The injection of chloroform is not to be recommended for the human subject." This remark is all the more noteworthy because Hunter was one of the earliest and most enthusiastic advocates of the hypodermic method. Eulenberg* simply repeats the remark of Hunter, and mentions an experience of Sandras, in which ten drops of chloroform were injected.

PHYSIOLOGICAL EFFECTS.—The effects produced by the injection of chloroform into the areolar tissue are these: vaporization of the chloroform, and consequent gaseous distention of the surrounding parts, painful swelling, inflammation, and, frequently, the formation of an abscess. The pain experienced by the patient at the moment of injection is also considerable, and as the needle is withdrawn the chloroform acts energetically on the wounded skin. These are very serious and almost insuperable objections to the *hypodermic injection* of chloroform. They are, to a

* Op. Cit.

large extent, obviated in the method of *deep injection*. It is true, in the latter method, considerable pain is felt and swelling arises, but the pain soon subsides and the inflammation rarely proceeds to suppuration. The pain is felt at the moment of injection and for some minutes subsequently, but this disappears and is succeeded by a feeling of numbness and anæsthesia of the parts into which the chloroform diffuses. A puffy swelling quickly forms at the site of the injection, and an induration of variable size forms, which is afterwards slowly absorbed. The numbness persists for a week or more. Systemic, or rather cerebral, sensations are felt usually only when the injection is inserted into the deeper parts of the face, and then are very transient, consisting only of a little giddiness followed by drowsiness. Indeed, the results, so far as systemic effects are concerned, may be regarded as absolutely free from danger. So much swelling and induration occurring at the site of an injection must occasion apprehension of the formation of an abscess. Thus far this untoward result has not happened in any of my cases or in any of the reported cases, with one exception. This was a man suffering from *tic douloureux*, in whom repeated injections were made about the supra- and infra-orbital foramina, a locality unsuited for *repeated injections*.

To ascertain more satisfactorily than is possible from patients the degree of suffering which attends the deep injection of chloroform, and the extent and duration of the resulting numbness, I practised an

experiment on myself by injecting ten minims of Squibb's chloroform deeply in the calf of the leg. The pain was by no means so severe as I had anticipated, and could easily, indeed, be borne. Considerable swelling resulted, and an induration as large as a filbert continued for two weeks, when it was absorbed entirely. Immediately after the injection numbness was experienced about the site of the injection; it then extended downwards, and on the following day had reached the bottom of the foot. A space in which the sense of touch and the appreciation of pain and temperature were decidedly diminished existed from the point at which the chloroform was inserted to the hollow of the foot, although somewhat irregular in shape, at least two inches in transverse diameter at any point. This condition of altered sensibility persisted for several weeks.

It is obvious, from the foregoing considerations, that chloroform injected into a part modifies the conductivity of the nerves. As *pain* means an irritation of a nerve or nerves, the perception by the centres of consciousness of this impression, and its reference outwardly to the peripheral distribution, we may assume, with some confidence, that chloroform causes an interruption in the route or circuit of transmission. It has long been known that swelling of a part, the seat of a neuralgia, is a signal of the cessation of the pain.

When the chloroform is injected into the deeper parts of the face, it comes into relation to vessels

having an intimate connection with the intra-cranial circulation. It is, of course, perfectly well known that the facial vein communicates with the pterygoid plexus and the cavernous sinus. This anatomical fact explains the greater cerebral effect of an injection of chloroform in the deeper parts of the face as compared with the same injection elsewhere.

THERAPY.—Since the publication of my original cases of *tic douloureux*, various cases of *neuralgia*—of the *fifth*, *cervico-brachial*, *sciatic*—have been treated by me successfully by the chloroform injection. This method is especially adapted to the treatment of sciatica. I have had under treatment since 1874 twelve cases of sciatica, all of great severity and all chronic, in which I used the chloroform injections, and of these eight were cured, two improved, and two received no benefit. I do not include in this summary those cases of sciatica which were symptomatic of spinal or cerebral disease. Other cases have been reported in this country and abroad in which this method succeeded after other approved methods had failed.* One of the most remarkable cases demonstrating its utility is that reported by Dr. J. B. Mattison,† in which not only was the neuralgia cured, but also the opium habit with which it was complicated.

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* Dr. de Cérenville, La Tribune Médicale, August 20, 1876; Dr. Collins, The Clinic, 1875.

† Medical Record, New York, May, 1874.

Strictly localized *spinal pain* and *coccydinia* have been cured by me by injecting the chloroform deeply near to the point of emergence of the sensory branches, or, in case of the pain in the coccyx, as deeply as possible about the point of greatest pain.

## XIV.

### CHLORAL HYDRATE, AND CHLORAL AND MORPHIA.

THE SOLUTION.—Crystallized chloral only is suitable for the preparation of solutions for hypodermic use. A saturated solution in water contains 50 *per centum* of chloral. Although this is rather irritating to the tissues, a weak solution may be more objectionable, as two punctures will be necessary to introduce the required amount.

℞.—Chloral. hydratis, ℥ss;
Aquæ destil., ℥j. M.
S.—Thirty minims contain 15 grains of chloral.

THE DOSE.—Chloral diffuses into the blood more rapidly from the subcutaneous areolar tissue than from the stomach. Under ordinary circumstances, ten grains will be a sufficient quantity for an adult; but special conditions may require more.

PHYSIOLOGICAL EFFECTS.—Very great pain and smarting are felt at the point of puncture, and it persists, unfortunately, for a half-hour or longer. Considerable swelling, an erythematous blush, and urticaria-like eruption take place about the puncture. A hard nodule, very prone to suppurate, usually forms. Especial pains are necessary to avoid penetrating a vein, for, although Oré has proposed the operation

of intra-venous injection for the purpose of inducing anæsthesia, the direct admission of chloral to a vein is considered so hazardous that the proposed expedient is almost universally condemned. The production of sleep is the result of the chloral injection, and this follows promptly, usually without any disturbance of function. In some subjects, however, just as when taken into the stomach, a period of excitement, with headache, precedes sleep, or, it may be, prevents it altogether. If the dose be sufficient sleep is very sure to follow, and the drowsiness comes on within five minutes after the injection is practised. The sleep of chloral is very like that of natural sleep, and there are no after-disturbances,—no headache, nausea, nor constipation.

Administered subcutaneously, chloral possesses distinct pain-relieving power, differing in this respect from the effects of its stomach absorption.

A weak heart, especially a fatty heart, is an important contraindication to the hypodermic injection of chloral, still more than to its administration by the stomach. Numerous deaths have resulted from its incautious use in cases of weak heart when taken by the stomach; the danger is greater, of course, when it is thrown under the skin.

THERAPY.—So unpleasant is the local action of chloral that its use by the hypodermic injection is restricted, usually, to cases in which the stomachal administration is prevented by the condition of that

organ, or by the inability or the unwillingness of the patient to swallow.

*Vomiting*, not controlled by the ordinary means, may sometimes, frequently indeed, be arrested by the injection of five to ten grains of chloral in the epigastric region. Obstinate *hiccough*, not amenable to the usual treatment, may also be stopped in the same way. In violent *cholera morbus* and in true *cholera* excellent results are obtained from the chloral treatment, better, in the author's experience, than from any other treatment. In the cholera epidemic at Riga in 1871, the injections were remarkably successful.* Similar successes attended the practice of Mr. Hall, an English army surgeon, at Kheri, Oudh, India,† of Nepven,‡ and others. During a short epidemic of cholera in Cincinnati in 1873, I had the most convincing proofs of its efficiency. When the cramps are severe and the algid state well advanced, very considerable doses must be used. In one very formidable case, in which there seemed but little hope, sixty grains were administered hypodermically in two hours, with the effect to stop the cramps, restore warmth, and to remove, indeed, all unfavorable symptoms.

In *asthma* decided relief is produced by the injection of chloral. Other *neuroses* of the chest organs

* O. Liebreich, Berliner klinische Wochenschrift, 1871, p. 408. Letter from Dr. v. Reichard.

† The Practitioner, July, 1875.

‡ Gaz. Méd. de Paris, September 13, 1873.

are equally benefited; but the utmost circumspection is needed lest a fatal result follow, by paralysis of a weak heart.

The hypodermic injection of chloral is indicated and may be employed in all *cerebral disorders* in which chloral is so much prescribed by the stomach: to procure sleep, to allay the excitement of mania, and to prevent convulsive attacks. The remedy is employed in this group of cases hypodermically, when the patient cannot or will not swallow it in the usual way. In superficial *neuralgiæ* the local use of chloral may be substituted for the deep injection of chloroform.

*Chloral and Morphia.*—In most of the cases for which chloral is directed in the preceding paragraphs the combination with morphia is to be preferred, generally speaking, to the chloral alone. As is perfectly well known, the pain-relieving power of chloral is greatly inferior to that possessed by morphia. A combination of the two makes an anodyne and hypnotic of the highest order of excellence: that which is wanting in one is supplied by the other, and in respect to their special properties, each adds to the power of the other. In a paper read before the New York Neurological Society, I showed that whilst morphia increased the physiological effects of chloral in all other respects, it prevented the depression of the heart's action caused by the latter, and thus obviated the chief danger from its administration.

The combination is rendered still more efficient by the addition of atropia. The following formulæ are intended to illustrate and embody the above principles, and may be employed for the hypodermic injection of these remedies:

℞.—Chloral hydrat., ʒiij;
Morphiæ sulph., gr. iv;
Aquæ destil., ℥i. M.

Sig.—Twenty minims contain $7\frac{1}{2}$ grains of chloral and $\frac{1}{6}$ grain of morphia.

℞.—Chloral hydrat., ʒiij;
Morphiæ sulph., gr. iv;
Atropiæ sulph., gr. $\frac{1}{3}$;
Aquæ destil., ℥i. M.

Sig.—Twenty minims contain $7\frac{1}{2}$ grains of chloral, $\frac{1}{6}$ grain of morphia, and $\frac{1}{120}$ grain of atropia.

## XV.

### CAFFEIN.

THE SOLUTION.—The preparation now used is the citrate, and as it is soluble in water, can be dissolved in that menstruum for hypodermic use.

℞.—Caffeinæ citratis, gr. xxiv;
Aquæ, ℥i. M.
Sig.—Twenty minims contain 1 grain.

THE DOSE will range from ten to twenty minims of the above solution, or from one-half to one grain.

PHYSIOLOGICAL EFFECTS.—The local effects are similar to those produced by other alkaloids. Slight drowsiness is an immediate effect, but this is quickly followed by stimulation of the brain and the other animal functions. In very large doses it produces decided excitement of the nervous and vascular systems, violent palpitation of the heart, with frequency, irregularity, and sometimes intermittence of the pulse, oppression and pain in the head, disorders of the senses, ringing in the ears, flashes of light before the eyes, priapism, and delirium.

THERAPY.—Caffein has been used hypodermically for the relief of *neuralgia*. Eulenberg found it useful in a case of occipital neuralgia. Dr. Anstie says with regard to it: "In one case of severe neuralgia

of the superficial branches of the circumflex in the shoulder, two successive injections of caffein (over the biceps) appeared to cut short the malady altogether. In a case of dorso-costal neuralgia, attending shingles, the patient was injected daily, for five or six days, with the effect of notably mitigating the pain on each occasion." Lorent used the hypodermic injection of caffein in *hysterical headache* and *migraine.* Dr. Anstie relieved by it the *insomnia* attendant upon chronic alcoholism without delirium. In these affections, as Anstie suggests, caffein will probably be found a valuable remedy.

Caffein is indicated in simple *melancholy,* in *hysterical paroxysms,* in certain cases of *delirium tremens;* but our knowledge is not yet sufficient to pronounce positively on these points. It has, also, been used with success against *opium narcosis;* in this state it is certainly inferior to atropia, yet, as there is no therapeutical incompatibility, these agents may be used simultaneously or in the same case.

## XVI.

### APOMORPHIA.

As a solution of apomorphia rapidly changes,—becoming greenish and unfit for use,—it should be kept in powder and the solution made when required. The dose for an adult by the subcutaneous areolar tissue is $\frac{1}{16}$ grain, and for children a proportional amount. As very serious symptoms have been produced by full doses, it is necessary to be circumspect, especially in the case of children.

PHYSIOLOGICAL EFFECTS.—In a few minutes after the injection is made some nausea, giddiness, and headache are experienced, and vomiting occurs abruptly and thoroughly in from five to twenty minutes. At the first effort the stomach is well emptied; but the vomiting recurs a few times at intervals of a quarter to a half hour. Such is the ordinary course of action of a sufficient but still small dose. If a full dose is given by the subcutaneous areolar tissue, there occur headache, vertigo, nausea, a cold sweat, a quick, small, feeble pulse, depression and drowsiness, and profuse vomiting, followed by prolonged sleep.

A very alarming condition of depression—a state of collapse, indeed—has been caused in children and inebriates by the hypodermic injection of a full dose. Toxic doses in animals cause at first great excite-

ment, vomiting, followed by muscular trembling, paralysis, and convulsions.* It does not seem to affect the blood-pressure,† nor the motor and sensory nerves; the respirations at first greatly increase in number, but ultimately become more shallow and infrequent, death occurring from paralysis of the respiratory function.‡

THERAPY.—The use of apomorphia hypodermically is confined to the production of vomiting.§ It is the most useful of all the emetics for *narcotic poisoning.* The evidence is convincing that profound insensibility hinders the emetic action, but an increase of the dose suffices to overcome this. If then in the treatment of poisoning by narcotic substances the usual dose does not have the desired effect, it must be repeated until vomiting does occur. It is highly probable that very much larger doses can be administered in the condition of insensibility from poisons than in ordinary cases of disease. It is extremely questionable to employ apomorphia in opium-poisoning, since this agent has an effect on the cerebrum, and causes death by paralysis of respiration. If the patient is

* E. Harnack, Archiv f. exp. Path. u. Pharmacologie, vol. ii. p. 291.

† Dr. Vincent Siebert, Untersuchungen über Apomorphia. Abstract in Schmidt's Jahrbücher, vol. clv. p. 14, et seq.

‡ Harnack, supra.

§ Gee, Note on Apomorphia, etc., St. Bartholomew's Hospital Reports, vol. v., 1869.

too profoundly narcotized for the action of emetics, the stomach-pump is an available and effective resource, and should unquestionably be preferred to the subcutaneous use of apomorphia.

In *capillary bronchitis*, to free the tubes of their contents, and in *croup*, to dislodge the false membrane, apomorphia is used to obtain the mechanical effect of powerful emesis. In common with other emetics it is supposed to possess expectorant properties, but it is never used hypodermically for this purpose.

## XVII.

### ERGOTIN.

THE SOLUTION.—The *Ergotin*, so called, employed in medical practice is not the supposed active principle, but an aqueous extract. Perfectly good ergotin is now to be obtained from various manufacturers, but the aqueous extract prepared by Squibb, of Brooklyn, for hypodermic injection is an excellent preparation,—the best, doubtless, to be obtained at present. This "extract of ergot is almost entirely soluble in cold water, and represents good rye ergot in the proportion of one grain of extract for five grains of ergot. Sixty grains of this extract dissolved in two hundred and fifty minims of water—the solution filtered and made up to three hundred minims by passing water through the filter to wash it and the residue upon it—makes a solution which represents ergot in the proportion of minim for grain, and is of the same strength as the fluid extract of ergot, but is free from alcohol or other irritant substance." Such are Squibb's instructions for the preparation of a solution. A much more concentrated solution can be prepared from Squibb's extract, which is soluble in water in the proportion of grain to minim, by simply rubbing up the extract with distilled water until saturated,—then filter. Of this solution, so prepared, from five to fifteen minims

may be injected,—the largest quantity in cases of great urgency and danger. The following formula may be used as a guide in the preparation of a solution:

℞.—Ergotin (aq. ex.), ℈ij;
Aquæ destil., ʒij.
M. Filter.
Sig.—From five to twenty minims at each injection.

Dragendorff and Podwissotzky propose their newly-discovered sclerotinsäure, in aqueous solution, for hypodermic injection, but at present this substance is too difficult to procure and too expensive to be used. Furthermore, the conclusions of these experimental physiologists are not yet well established in professional opinion, and may prove to be erroneous; nevertheless they assert with confidence that "the special, active substances in ergot are sclerotinic acid and scleromucin."*

As solutions of ergotin undergo important changes in a short time, it is desirable to prevent them, if this result can be accomplished without impairing the quality of the material. The addition of one per cent. of carbolic acid will prevent any change for several months, and this rather increases than lessens the therapeutical power of the solution.

PHYSIOLOGICAL EFFECTS.—Considerable pain,-

* Archiv für experimen. Pathologie u. Pharmakologie, vol. vi. p. 153. Ueber die wirksamen und einige andere Bestandtheile des Mutterkornes.

lasting for several minutes, attends the injection, and a tumefaction, subsequently sometimes hardening into a firm nodule, forms at the site of the puncture. It is rare, however, for suppuration to occur.

If a moderate dose is injected, there may be no symptoms whatever produced. Frontal headache, transient giddiness, more or less dilated pupils, are produced by full doses in from fifteen minutes to a half-hour. In a somewhat longer time,—an hour or two after the injection,—sometimes quite severe rhythmical pains come on, referrible to the region of the uterus, and undoubtedly uterine in seat. Women experienced in the sensation, spontaneously, liken the pains to those of the first stage of labor. In a case of uterine fibroid expelled from the cavity by the action of ergotin hypodermically used, severe rhythmical pain always came on in a half-hour after the injection. That these pains are uterine seems highly probable, not only in respect to the examples cited above, but because of the unquestionable action of ergot on the parturient uterus. The cases are parallel, for when subinvolution exists, or when a fibroid is contained in the uterine cavity, the muscular development of the organ is sufficient to permit the action of ergotin to take place. On the other hand, ergot unquestionably affects the muscular fibre of the intestine, but in the examples of pain above referred to there was no increased intestinal action.

When considerable daily doses of ergotin are injected, the patients complain of a sense of pressure,

with pain and numbness in the muscles of the thighs and legs. They also complain of fatigue on slight exertion, of a sense of coldness of the limbs at night, especially, and muscular cramps of varying severity and persistence. The bladder, too, or, rather, the sphincter, is kept in a state of spasm when daily doses are administered, so that micturition becomes slow, difficult, or impossible, the catheter becoming necessary.

The actions of ergot have been studied by many observers, and their reported observations differ widely, and are often, indeed, diametrically opposed. Faulty methods are frequently responsible for discordant and contradictory views. Thus, attempts have been made to arrive at a knowledge of the influence of ergot on the blood-pressure by injecting a quantity of the infusion or fluid extract into the jugular vein. We are told, with a remarkable *naïveté*, that under these circumstances the blood-pressure at first falls and then rises remarkably. Prof. Wood confirms what Dr. Holmes has asserted with regard to this experiment. Brown-Séquard long ago demonstrated that ergot had the power to contract the vessels, and this fact has since been confirmed by a number of observers at different periods,*

* Among those who have demonstrated the narrowing of the vessels caused by ergotin are the following: Dr. H. Kochler. Vergleichend-experimentelle Untersuchungen über die physiologischen Wirkungen des Ergotin Bonjean und des Ergotin Wiggers. Virchow's Archiv, vol. lx. p. 381. M.

and he also asserts that which in itself has a high degree of probability, that the vaso-motor spasm which first comes on is followed by vaso-motor paralysis. The results of the very numerous experiments made are nearly uniform in proving that ergotin causes a rise in the blood-pressure, a necessary sequence of the contraction of the arterioles. The particular constituents of ergotin effecting this result have been ascertained by recent investigations. Köhler devoted himself especially to determine the physiological effects of the "Ergotin" of Bonjean, and of the "Ergotin" of Wiggers,—the former being an aqueous extract merely, and the latter a conjectural active principle. His researches proved that the former possessed the properties belonging to ergot, the latter exhibited powers of a different kind. The most recent and valuable contribution to our knowledge of this subject is the research of Podwissotzky on sclerotinic acid, a new product of ergot, a knowledge of which we owe—as has been shown—to Dragendorff and Podwissotzky.* These experiments have demonstrated (apparently) that this new substance is the

Laborde, Gazette des Hôpitaux, March 10, 1877. Dr. A. Wernich, Beitrag zur Kenntniss der Ergotinwirkungen. Virchow's Archiv, vol. lvi. p. 505. This research was in part determined by some experiments of Handelin, made under the direction of Schmiedeberg,—these experiments having shown that ergotin causes the blood-pressure to fall.

* St. Petersburger med. Wochenschrift, Aug. 27 and Sept. 8, 1876.

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...ber, vol. clviii.

The following is a summary of the symptoms of *acute ergotism* in man: nausea, vomiting, abdominal pain, dryness of the throat, thirst, anorexia, itching of the extremities, numbness, lassitude, vertigo, dilatation of the pupils, drowsiness, delirium and stupor, diminution of the force and frequency of the pulse (rarely the opposite state), with tendency to syncope, pallor and lividity of the face, etc.

*Chronic ergotism*, witnessed occasionally on a large scale by reason of the consumption of diseased rye as food, exists in two forms,—*convulsive* and *gangrenous*. Generally the convulsive form begins by vertigo, disorders of vision, *tinnitus aurium*, numbness of the fingers and toes, and afterwards of the whole integument. Tetanoid cramps follow,—of the fingers, of the forearms, on the arms, and of the arms against the chest; of the toes, on the palmar surface of the foot; of the leg, on the thigh. The muscles of the thorax, abdomen, and diaphragm are also attacked, making respiration difficult and painful, and inducing attacks like asthma. Cramps of the same character attack the intestine,—the muscular layer,—and pains like colic and diarrhœa ensue, but the appetite continues ravenous. Usually, or at least frequently, the uterus becomes affected, expulsive pains come on, and abortion takes place. The action of the heart is weak and slow, the pulse feeble, the surface cold. At first the spasms are occasional, but they become more frequent, ultimately continuous, resulting in opisthotonos or emprosthotonos. Complete anæsthesia

of the whole surface succeeds to the tetanoid attacks, and gangrene in spots of small extent may occur. The organs of sense lose their power to react to their physiological stimuli, and taste, hearing, and smell are abolished. The pupils are dilated, sometimes unequal, and various disturbances of vision ensue. Epileptiform attacks may occur as well as the spasms; delirium sets in, and the poor victim passes into a state of complete insensibility.

The convulsive and gangrenous forms, although clinically separable, are not pathologically very different. The gangrenous form sets in by tingling, numbness, formication, an insupportable sense of fatigue in the members, an earthy hue of the skin, coldness of the surface; nausea, vomiting, and diarrhœa then occur; muscular contractions take place; an eruption of vesicles filled with a dark ichorous fluid appears on one or more extremities; and gangrene, dry or moist, quickly destroys the toes, the legs, the nose, or other parts. Doubtless, not unfrequently, owing to the contraction of the arterioles in front, a weak heart behind, and blood containing a great excess of fibrin, sudden coagulation of the blood in a large vessel takes place, and gangrene of a member is the result. These are the factors probably concerned in the formation of gangrenous spots of greater or less size.

To enter so largely in the consideration of these topics may seem an unnecessary elaboration, but at the present time so freely is ergotin used, and in such

large doses, that any details in regard to the results of its administration should not be omitted.

THERAPY.—The therapeutical uses of ergot are based on the modern conception of its physiological actions.

One of the most effective remedies against *hemorrhage* in any situation not remediable by surgical means is the hypodermic injection of ergotin. Originally used against *uterine hemorrhages*, it has become generalized in its application to the treatment of hemorrhage in general. Not to enter into tedious details, it will suffice to state that the hypodermic injection is the most effective way of treating all cases of uterine hemorrhage to which ergot is adapted.

*Subinvolution of the uterus*, a state of things fruitful of mischief, is most effectively treated by a daily hypodermic injection of ergotin.* The same treatment used persistently, about twice a week, will cure the so-called *chronic metritis*. Local thickening and *hypertrophy* of the uterine wall just developing into, or well-formed, intra-mural *fibroids* can be cured in a large proportion, and are being cured since the beneficent discovery of Hildebrandt† was announced. The relative proportion of cures to cases cannot be stated in numbers, notwithstanding the enormous

* Keating, Amer. Journal of Med. Science, July, 1873.

† Berliner klinische Wochenschrift, June 17, 1872.

experience now accumulated. Selecting out of a mass of reports, probably no better or more accurate can be found than that of Prof. Byford, of Chicago. Of his group of 101 cases, 22 were cured, and all the rest, except 21, were more or less ameliorated. Various modes of introducing the agent were employed, and probably not all were treated by the best method, or by ergotin of the best quality. Besides the arrest or diminution in the growth, it is, as Prof. Hildebrandt remarks, "of great significance that those distressing symptoms, the profuse hemorrhages, the debilitating serous discharges, and the harassing pains, totally disappear."

Hypodermic injections of ergotin are also used to effect the expulsion of *polypi* from the uterine cavity. The *hydatid mole* may be most effectively expelled by the same agent.

*Hypertrophied prostate*, as Prof. Langenbeck has shown, may be reduced in size by the subcutaneous injection of ergotin. I have succeeded better, I think, by injecting the lobes of the prostate through the rectum, an expedient which is easily practised. A bivalve rectal speculum must be first introduced; then vessels felt for, and the point for puncture selected, when the needle may be introduced and some five minims inserted. The utmost care must be exercised in regard to each detail, for inflammation and suppuration of the prostate would be a serious addition to the sufferings and hazards of the case. Hemorrhoids that are recent, not previously inflamed,

and bleeding in consequence of increase of pressure in the portal system, can be relieved greatly by ergotin injections.

*Varicocele*, if not too far advanced in respect to the size of the vessels and atrophy of the testis, may be cured by the injection of ergotin. The needle must be inserted between the vessels, and entrance into a vein avoided,—a fact which must be ascertained with absolute certainty,—and the fluid must be sufficient in amount to diffuse among the vessels. Great pain attends the operation, so great that the patient may faint or suffer considerable shock, and there will be subsequently a good deal of inflammation and swelling, with the usual concomitants of feverishness and pain. An injection of ergotin on the dorsum of the penis in the neighborhood of the dorsal vein is an efficient expedient to promote the vigor of the *erections* when they are not well maintained. Injections in the perineum once a week is an excellent remedy in cases of *spermatorrhœa* with feeble erections and a discharge of mucus from the urethra.

Probably the most efficient means we now possess for the arrest of *hæmoptysis* is the hypodermic injection of ergotin. It acts promptly, and does not interfere with the simultaneous use of other means of treatment, but the injection is usually sufficient of itself. Numerous cases of hæmoptysis have been reported in the treatment of which ergot was the principal or only agent employed, but the most careful recorded and instructive series of cases which have

come under my observation are those of Dr. Anstie.* His conclusions are as follows:

"We have now established the facts (*a*) of the direct action of ergot in the cases which I have recorded; (*b*) of its superiority in several of these cases to other styptics that had been tried; (*c*) the probability, from physiological analogies, that ergot would act more universally as a checker of hæmoptysis than the routine remedies with which we are familiar; (*d*) also, that it is perfectly safe for the purpose in view, and in this respect is superior to digitalis, which otherwise resembles it a good deal." These good effects were obtained by the stomachal administration, but Dr. Anstie makes a remark which has been abundantly confirmed since,—"For getting the best results, I can scarcely doubt that the hypodermic injection of ergotin is a decidedly superior method."

Scarcely less important than Hildebrandt's discovery of the value of ergotin in uterine fibroids is the observation of Langenbeck with cases showing the curative power of the ergotin injections in *aneurism*.† Soon after the cases of Langenbeck were reported, Plagge,‡ of Darmstadt, published a case of traumatic popliteal aneurism, in which the ergotin injections were signally beneficial. In a case of femoral aneurism, Schneider has succeeded by the ergotin injec-

* The Practitioner (London), vol. x. p. 279.

† Berliner klinische Wochenschrift, No. 2, 1869.

‡ Betz's Memorabilien. Quoted in London Medical Record, vol. ii. p. 87.

tions, and Dutoit in one of the subclavian.* I have myself seen remarkable diminution in size and great improvement in condition in a case of aneurism at the transverse arch of the aorta, death being due to other causes entirely. After death the walls of the aneurism were very thick and firm by deposition of successive layers of fibrin, and rupture was not possible. In Langenbeck's and other successful cases the aneurisms treated were on superficial arteries, except that of Dutoit. It has been asserted that these injections are idle in the case of aneurism of the aorta, since this possesses but rudimentary elements of the organic muscular fibre to be acted on by such an agent as ergot. Such critics overlook the fact that ergot, by slowing the heart and raising the tension at the periphery by contracting the arterioles, offers the most suitable conditions for securing the coagulation of blood in the aneurismal sac.

In *varicose veins,* Voit† has proposed and has used successfully injections of ergotin in the immediate neighborhood of the diseased vessels.

*Enlarged spleen* has been cured by the injection practised at any indifferent point,‡ but preferably under the integument of the abdomen.

The disease *leukæmia,* which is closely connected

* Berliner klinische Wochenschrift, 1872, p. 115. Quoted from Langenbeck's Archiv, Band xii.

† Berliner klinische Wochenschrift, supra.

‡ Dr. Miller, N. Y. Med. Rec., April 15, 1876, and Dr. Da Costa, who was the first, in Amer. Jour. Med. Sci., Jan. 1875.

pathologically with a condition of the spleen, has been cured by Dr. Da Costa, and *exophthalmic goitre* benefited by the same treatment.

Brown-Séquard was undoubtedly the first to use ergot systematically, and from the stand-point of a correct appreciation of the nature of its action, in disease of the brain and nervous system. It has been used with advantage, hypodermically, in the treatment of the *acute affections* of the *meninges* of *the brain and spinal cord*, and in *cerebro-spinal meningitis*. It is highly serviceable in these affections if used at the proper time—during the stage of excitation—and before depression comes on, when it is harmful. It ought to be serviceable in those cases of *cerebral hemorrhage* in which the escape of blood occurs slowly and there is a gradually deepening coma.

In the congestive form of *migraine*—flushed face, injected conjunctivæ, quick pulse, severe pain coincident with each arterial pulse—the hypodermic injection of ergotin is highly useful, and often affords immediate relief. In ordinary *headaches* of the congestive variety, but not in the headaches of anæmia, it is equally efficient and curative. The most ardent and comprehensive advocate for the use of the subcutaneous injection of ergot is Dr. Marino,* who finds it superior to all remedies in *sunstroke*, *tic douloureux*, and *hemicrania*. In *sciatica*, the results of its use are sometimes "brilliant," but it often fails without apparent cause.

* Quoted in London Medical Record, vol. v. p. 456.

## XVIII.

### QUINIA.

THE SOLUTION.—Opinions are divided in respect to the proper solution of the sulphate, and as to the salt of quinia which should be used for the hypodermic injection. Since the last edition of this monograph was published, and very recently, important recommendations have been made in respect to the particular salt which should be employed. As the sulphate has been chiefly used, I first submit to the reader the best formula with which I am acquainted for the administration of this salt hypodermically:

℞.—Quiniæ, di-sulph., gr. 50;
Acid. sulphuric. dil., ♏ 100;
Aquæ font., ʒi;
Acid. carbolic. liq., ♏ 5.
Solve.

"Place the quinine and water in a porcelain dish over a spirit-lamp; heat to the boiling-point, and add the sulphuric acid, stirring with a wooden spatula. Filter at once into a bottle, and add the carbolic acid. This gives six grains to the drachm. Even this solution will deposit some crystals at a temperature of 50°, and, of course, at or below that temperature requires to be warmed before using."—Lente.*

* The New York Medical Journal, March, 1874.

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skin, excite considerable burning and a
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the puncture. If care be not used in the
ation of the solution, inflammation will follow
the site of the puncture, matter will form, and
ssibly a diffuse inflammation of the areolar tissue
will ensue. Before I had learned the necessity for
caution, accidents of this kind occurred in my own
hands, and lately some very bad cases have been re-
ported as occurring in New Orleans, where, it is said,
a *mixture* of quinia sulphate and water was injected
under the skin. Some cases of tetanus have been
reported caused by subcutaneous injection of quinine,

* Centralblatt f. d. med. Wiss., June 14, 1879. Quoted in the Medical Times and Gazette, July 12, 1879.

but there must have existed a peculiar state of the nervous system, in which, as is well known, very slight injuries may be followed by this malady. But little systemic effect follows the subcutaneous injection of quinia. The actions are similar in character to those produced by the stomach administration, and, as they are so well known, require no description here.

Dr. Chasseaud published, in 1862, an account of the great success which he had obtained in the treatment of *malarial fevers*, in the hospital at Smyrna, by the subcutaneous injection of quinine. He ascertained that this agent, administered in this way, had a more decidedly curative power, without occasioning its usual physiological effects, than when given by the stomach. This practice has since been continued with undiminished success at the same hospital by Dr. J. McCraith. Dr. Moore, of the Bombay Medical Service, repeating these experiences, concludes "that four or five grains of quinine injected beneath the integument are equal to five or six times that amount taken into the stomach."

Not only is the immediate therapeutic effect of the quinine given in this way greater, but more permanent cures thereby result. In one hundred and fifty cases treated in this way, Dr. Chasseaud had but a single relapse. Such has been my own observation.

From five to ten grains, injected under the skin, will suffice to cure an ordinary intermittent. Fevers

of the remittent type, and pernicious fevers, will require a larger amount. In those deadly malarial attacks, known as *pernicious*, is the efficacy of this treatment most conspicuous. Much depends, as everybody knows, upon bringing the patient promptly under the quinine influence; the subcutaneous injection is the quickest and most powerful means of accomplishing this object.

*Recent malarial fevers* may be aborted at the beginning of the cold stage by a full injection, but it is better to anticipate the attack by an hour or two, in order to procure the physiological effects before the onset of the expected paroxysm. It is true that the injection may be administered at any time during the febrile movement, but it is better to anticipate and prevent it. The ultimate cure will depend upon the amount of quinia received by the patient, and not upon the period at which it was administered.

The subcutaneous injection is much more effective also against *chronic malarial poisoning* than the stomach administration, but here we meet with new conditions, requiring other management than the use of quinine. We may confidently expect to prevent the febrile movements by frequent repetition of the injection; but we do not thereby cure the disease, for the changes induced by the long-continued action of malaria, in the liver, spleen, gastro-intestinal mucous membrane, cerebro-spinal axis, must be corrected if we would arrest the objective phenomena of fever and cure the patient.

Dr. Eulenberg sums up his conclusions in regard to the cases in which the subcutaneous injection of quinia in malarial fevers may be desirable as follows:

In intermittents complicated with gastric disorder.

In children in whom the disagreeable taste and the large doses necessary produce strong aversion and stomach derangement.

In poor and hospital practice, where economy in the use of the drug is desirable.

These conclusions seem to the writer well founded. But he has omitted chronic malarial poisoning, in which the subcutaneous injection of quinia has undoubted utility.

The antipyretic effects of quinia are constantly made use of in the treatment of continued fevers, as all the world knows, the administration being by the stomach; but Dr. Ravicini* urges the hypodermic use of quinia in typhoid. He combines a minute quantity of morphia with it. He gives three injections daily, making in the aggregate about 70 grains, and this practice he continues for several days. The results are most favorable: the sordes disappear from the mouth and teeth, the headache, meteorism, and gurgling in the right iliac fossa are greatly diminished, the spleen is reduced in size, and the countenance becomes composed. The disease, although not so much abbreviated, as nearly all conva-

* Bologna. Quoted in the London Medical.

lesce at the end of the second week, or, at most, of the third. The morphia, he thinks, affects the nervous phenomena favorably. If these statements can be relied on, nothing can be more satisfactory than this mode of treating typhoid. By using the new compound—muriate of quinia and urea—there need be no apprehension, which otherwise might be felt as to the effect of an irritant on the tissues of a typhoid fever patient.

Mr. Hall,* of the British army, serving in India, reports remarkable success in the treatment of *heat-apoplexy* (sunstroke) by the hypodermic injection of quinine. He reports in all seven cases of a severe type in which this treatment proved uniformly and invariably successful. He refers also to the experience of Mr. Waller, of Calcutta, which was equally favorable.

In some cases of *neuralgia* good results have been obtained by quinia, subcutaneously. One notable example of ovarian neuralgia, accompanied by, or caused by, menorrhagia, has been reported, and I can confirm from personal observation the special utility of quinia under these circumstances.

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* The Practitioner, March, 1876.

## XIX.

### CARBOLIC ACID.

THE SOLUTION.—The following formula is a suitable one for the preparation of a solution of carbolic acid for hypodermic use:

℞.—Acid. carbolic. purif., gr. x;
Aquæ destil., ℥i. M.
Sig.—Two *per centum* solution of carbolic acid.

THE DOSE.—From fifteen to thirty minims—even as much as ʒi—of the above solution may be injected, but not more than the largest amount once in six hours. The minimum dose may be administered very frequently, until the maximum amount prescribed is reached. The quantity at each injection and the frequency of repetition will, however, depend on the character of the case.

PHYSIOLOGICAL EFFECTS.—Some smarting attends immediately, but declines rapidly, and is replaced by a local anæsthesia and analgesia extending for some distance around the puncture. Usually very little irritation is produced, and it is rare for an inflammatory induration and suppuration to follow. No change occurs in the feelings and condition of the patient, due to the carbolic acid. Elimination takes place by the bronchial mucous membrane to a slight extent, also by the skin, but chiefly by the

days. If the injections have been practised frequently and in considerable quantity, the characteristic changes in the appearance and reaction of the urine are observed. A slight smoky appearance may be disregarded, but if the urine becomes persistently blackish, the administration should be lessened or suspended.

THERAPY.—Important results have been obtained from the subcutaneous and parenchymatous injection of carbolic acid. The original conception suggesting its employment was the supposed relation of certain morbific ferments to diseased processes. Influenced by these notions, Kunze,* of Halle, employed it in these maladies (Infectionskrankheiten), notably in *erysipelas*, and, as it proved, with excellent results. Some experience of my own is quite confirmatory. By injecting five minims of a two per cent. solution just at the margin of the inflammation, and at several points, two or three times a day, a very favorable influence on the case is at once apparent. Kunze found the same practice very beneficial in *pleuro-pneumonia*. The injections had the effect to lower the temperature and the pulse-rate. Aufrecht† has repeated the same practice and confirmed the results of Kunze.

The practice has been greatly extended by Hüter,‡

* Schmidt's Jahrbücher, vol. clxiv. p. 147. † Ibid.

‡ Ibid., vol. clxiv. Also Dr. Rothe, Die Carbolsäure in der Medicin, Berlin, 1875, p. 40, et seq.

under the title of "parenchymatous injections,"—*Form parenchymatöser Einspritzungen*,—and applied to the treatment of *synovitis, white swelling, adenoma, bubo, fibroma*, etc. A two per cent. solution is thrown into the cavity of the joint every day or two, and into the substance of the abnormal growths. In some cases remarkable results of a curative kind follow, as I have ascertained by actual trial. In several instances I have seen ulcers of the face, which had all the external signs and appearances of *epithelioma*, heal and cicatrize permanently under the influence of carbolic acid injections so practised that the medicament came into contact with the tissues immediately adjacent to the diseased tissue. The needle was entered in the sound tissue just at the margin of the disease, and passed well under the ulcer, so that the carbolic acid solution could diffuse thoroughly through the parts. If necessary, two or more punctures can be made at one sitting.

In *acute rheumatism* decided relief has been produced by these injections about the affected joints; they are still more efficient in *chronic rheumatism*, and also do good in *myalgia*. Superficial *neuralgiæ* may not unfrequently be promptly cured by deep injections of the two per cent. carbolic acid solution instead of chloroform.

## XX.

### MERCURY.

THE SOLUTION AND DOSE.—Applying the rules given in Part I., I reject all insoluble preparations of mercury. Scarenzio* used in 1864 a mixture of calomel, glycerine, and water. Hebra† injected a solution of sublimate—gr. i to ʒss aq. Hill, of England, made use of a solution of sublimate containing $\frac{1}{6}$ of a grain to the dose. Lewin,‡ who first submitted this practice to systematic examination, employed a weak solution of corrosive sublimate. The following is a suitable formula for hypodermic injection of mercury:

℞.—Hydrarg. chlor. corrosiv., gr. i;
Aquæ destil., ʒi. M.

Ten minims of this contain $\frac{1}{48}$ of a grain. As Lewin, and especially Liégeois, have shown that concentrated solutions are not desirable and that large doses are not necessary, this formula will be strong enough for ordinary purposes. Recognizing the fact that induration of the tissue, and frequently unhealthy and sloughing ulcers, were produced by these

* Eulenberg, op. cit., p. 307.

† Ibid. Also, Bulletin de Thérapeutique, vol. i., 1869, p. 297. De l'Application de la Méthode hypodermique au Traitement de la Syphilis par les Preparations mercurielles. Par le Dr. F. Bricheteau. Ibid., vol. ii., 1869, p. 158, by M. Liégeois.

‡ Ibid.

injections of sublimate, Bricheteau requested M. Bouilhon, a Paris pharmaceutist, to prepare a salt of mercury soluble and free from irritant properties. M. Bouilhon suggested the double iodide of mercury and sodium as supplying the conditions required.

℞.—Hydrarg. et sodii iodid., gr. xxiv;
Aquæ destil., ℥iij. M.

Fifteen minims of this contain $\frac{1}{4}$ of a grain. Ten minims, or $\frac{1}{6}$ of a grain, will generally be sufficient for an injection. "This salt," says M. Bouilhon, "fulfils perfectly the object; it introduces into the economy only the active substance combined with a small quantity of a salt of soda." But as this salt is difficult to prepare, and as the corrosive chloride is more readily procured, the latter will generally be employed. With suitable precautions, abscess will not frequently result from its use. Thus, Lewin,—who used his solution, which is stronger than that I have recommended,—many hundred times, found small abscesses to occur in the proportion only of two to three for one hundred injections.

The formula of M. Liégeois* is as follows:

℞.—Hydrarg. chlor. corrosiv., gr. iij;
Morphiæ sulph., gr. iss;
Aquæ destil., ℥iij. M.

Fifteen minims of this solution contain $\frac{1}{32}$ of a

* Bulletin Général de Thérapeutique, 30 Août, 1869, p. 158.

grain, the quantity recommended by Liégeois for a single injection. It will be perceived that this solution contains the same quantity of sublimate as the formula I have proposed, but only about one-third of that used by Lewin. In two cases only has Liégeois observed abscess and eschar follow his injection. This comparative immunity from ill effects is to be attributed, unquestionably, to the small proportion of sublimate. The injection is preferably inserted under the skin of the back.

PHYSIOLOGICAL EFFECTS.—The injection of the corrosive chloride is accompanied by severe burning pain and considerable local heat and redness. If the solution be concentrated it will produce induration of the areolar tissue, inflammation and abscess, and sometimes a dry eschar, leaving an ulcer slow to heal. The intensity and persistence of the pain will depend upon the quantity of sublimate injected; weak solutions do not occasion much distress; the pain of any solution may be much mitigated by the conjoined use of morphia, as in the solution of Liégeois.

Salivation is frequently produced, according to Lewin, who had fifty-one cases of mercurial stomatitis in one hundred and forty-four men treated in this way. On the other hand, Liégeois found salivation an "exceptional" occurrence, there being only four in one hundred and ninety-six subjects, and these were mild cases. The difference in result here is plainly

due to the difference in the strength of the respective solutions. It is a curious and important circumstance that this physiological effect has no relation to the therapeutical results in syphilis, for Liégeois's cures are even more numerous, proportionally, than Lewin's.

The subcutaneous injection of sublimate does not impair any of the functions, but increases the activity of the digestion and assimilation, so that decided increase in weight takes place in most of the cases in which it is employed.

THERAPY.—The therapeutical applications of mercury by the hypodermic method are confined to the treatment of syphilis, in which results of the greatest value have been obtained.

It is applied to the treatment of primary (infecting chancre), secondary (constitutional), and tertiary forms of this disease. I have used it with great advantage in the tertiary, but have not had the opportunity to give it sufficiently numerous and prolonged trials to enable me to pronounce as to its utility in primary and secondary syphilis. I therefore avail myself of the very full reports and statistical evidence published by George Lewin, of Berlin, and M. Liégeois, of Paris. The following are the statistics of Lewin:

Cases* treated exclusively by injections of sublimate, 107; relapses 24, or 22 in 100.

* These statistics are based upon cases of constitutional syphilis.

"Cases treated by injections of sublimate, after sarsaparilla decoction and sweating, 58; relapses 19, or 30 in 100.

"Cases treated simultaneously by injections of sublimate, sarsaparilla decoction, and sweating, 24; relapses 7, or 33 in 100.

"Cases treated by injections of sublimate and iodide of potassium, 60; relapses 14, or 23 in 100.

"Cases treated by injections of sublimate and chloride of potassium, 60; relapses 14, or 23 in 100."

To sum up—356 patients have been treated by injections of sublimate, either singly or joined to other means; the relapses have been 89, or 25 in 100.

With the ordinary means of treatment, the relapses are 81 in 100 cases.*

The conclusions arrived at by Lewin,† as a result of his large observations, are the following:

1. The syphilitic phenomena disappear quickly, and with a rapidity proportional to the quantity of sublimate daily injected.

2. Certainty and precision of the method, as ascertained by nine hundred observations made during two years and a half.

3. Lessened number of relapses, and those that occur are light.

4. Facility of execution.

* Bulletin de Thérapeutique, vol. i., 1869, p. 300. Abstract of Lewin's researches by Bricheteau.

† Ibid.

The statistics of Liégeois are even more favorable. Thus, of 196 cases of constitutional syphilis, treated by injections of sublimate, 127 were cured, and 69 were ameliorated. For the cured, the number of injections were 68; for those ameliorated, 50. The number of relapses in those noted as cured were 12 (9.45 in 100); for those noted as ameliorated, 14 (20.30 in 100). The greater number of injections, and the increased length of time required by Liégeois's method as compared with Lewin's, are due to the small quantity injected, but these disadvantages are more than counterbalanced by the greater proportional number of cures. The production of salivation, then, is unnecessary in order to secure the best results from the hypodermic injection of mercury. The longer the constitutional symptoms have existed, the greater the number of injections required to effect a cure.

In practising the injection, the back should be selected for the site of the puncture. Two injections, of 8 minims each, may be practised at one sitting, one on each side. This quantity should be inserted daily. If the symptoms be not urgent, if time is of little consequence, and if it be desirable to avoid salivation, the daily quantity may be much less.

With the view to avoid the irritation produced by subcutaneous injections of corrosive sublimate in the ordinary way, and also to administer it in larger doses, Dr. Staub conceived the idea of using it in the

form of an albuminous solution in alkaline chlorides. He prepared his solution as follows:

Corrosive sublimate, 1 gr. 25.
Chloride of ammonium, 1 gr. 25.
Chloride of sodium, 4 grs. 15.
Water, 1 gr. 25.

After filtration this solution is added to an albuminous solution (white of one egg to 125 parts of water). Twenty drops of this contain 5 milligrammes of sublimate. It produces no irritation when injected under the skin. The results of treatment with this solution have been very favorable in the hands of M. Staub. He reports 44 observations, the treatment varying from 17 to 34 days, and the amount injected being 1 centigramme daily. He observed no relapses.*

* Archives Générales de Médecine, Juillet, 1872.

## XXI.

### ARSENIC.

AMONG the few observations on the subcutaneous injection of arsenic which I have been able to find, are a brief note by Eulenberg on the use of Fowler's solution by Prof. Lehman in a case of "pernicious puerperal fever," and in Reynolds's "System of Medicine." In an article on chorea* in the latter work, Dr. C. B. Radcliffe has presented some interesting facts on this subject, which I subjoin.

"This patient had suffered for nine years with a distressing choreal affection of certain muscles of the neck, by which the head was kept continually turning and bobbing. At different times various modes of treatment had been tried, including the hypodermic injection of morphia and atropia, without the least benefit. . . . The idea of injecting arsenic hypodermically occurred to me on the 12th of January, 1866, and was carried out the same day. Fowler's solution was chosen, and the part selected was the most tender point over the contracting muscle." Commencing with three minims, the quantity injected was finally raised to fourteen minims. "Before the fourth injection was practised, a marked change for the better had taken place; before the

* Vol. ii. p. 133, et seq.

eighth, the choreal movements were almost at an end, and a change for the better had gone on steadily from the beginning." Dr. Radcliffe reports another case in which amelioration, equally as great, was produced by the hypodermic injection of arsenic, the patient being a lady sixty years of age. He has also employed "with results more or less satisfactory the hypodermic injection of arsenic in certain cases of neuralgia, epilepsy, and other affections of the nervous system."

In the choreal cases above referred to, Dr. Radcliffe's "object in introducing the arsenic hypodermically was not to escape gastric irritation, but to produce some local change in the nerves of the parts which were the seat of the disorder, as well as to bring about some more general change in the system."

Dr. Radcliffe employed for these injections at first the undiluted Fowler's solution, but as considerable local irritation followed, he afterward diluted it by one-half water. This proved much less irritant. It is probable, I think, that the *Liquor Sodæ Arseniatis* will be found much better for hypodermic use than Fowler's solution. This being a higher oxide than the arsenite of potassa, is less irritant in its local action and less apt to produce arsenical poisoning. Moreover, it is a clear solution, possessed of a considerable degree of osmotic power. The solution of the arseniate of soda may be injected in quantities of five to ten or even fifteen minims. Every alternate day is sufficiently often in ordinary cases to make

the injection. It will be found advisable not
sert the solution frequently in the same neighb

M. Lipp* has proposed to use arsenic sul
ously in cases of psoriasis and chronic eczer
reports three cases thus treated successfu
injected from one to two centigrammes of
acid. The general symptoms produced by
jections were elevation of temperature, a
of pulse, diminution of appetite, increa
and diuresis, nervous excitement, headac
cough, redness of conjunctiva, etc. The
which M. Lipp claims are the smallness
the shorter duration of the treatment, an
of injury to the digestive organs.

* Archiv für Dermatologie und Syphil..

## XXII.

### AQUAPUNCTURE.

THE method now designated aquapuncture consists merely in the subcutaneous injection of water at ordinary temperature. A special instrument has been invented by M. Guérard for the simultaneous introduction of a number of fine streams of water (*douches filiformes*), but an ordinary hypodermic syringe will answer the purpose very well by making a number of punctures within a certain area.

The immediate effect of the sudden introduction of a fine jet of water is a sense of burning, which lasts a few minutes, a feeling of distention and warmth lasting longer, for about the point of puncture considerable swelling takes place, presenting the appearance of a wheal of urticaria. The immediate effect of the introduction of cold water is to cool the nerve-filaments; of hot water to raise their temperature, and the distention of the parts stretches the nerve-filaments. Undoubtedly, therapeutical effects are produced by such impression. What difference of physiological or therapeutical effects will follow the introduction of very warm or very cold water, or greater or less stretching of nerve-fibres, remains to be determined by further investigations.

The method of aquapuncture has been used in fourteen cases of various forms of *neuralgia* by

Servajan, with the result of a cure in all but one. Among these were examples of facial, sciatic (5), lumbar (3), and other forms.

The injection of water has been gravely proposed* as a substitute for morphia in the treatment of painful affections, and a medical eccentric has propounded the extraordinary theory that the systemic effects of a solution of morphia are due not to the morphia, but to the water! If this was not intended as a practical joke, if the author is really sincere in his opinions, it is a curious example of that morbid desire for notoriety, which is without conscience or the sense of shame.

Water injections have been used with success to deceive the patient in cases of morphia habit of a few days' or few weeks' duration; but ancient and experienced morphia-takers cannot be so deceived, for they quickly realize the difference in the amount of effect produced. In making an effort to cure them, it is never useful to practise any deceit; their co-operation must be sought and their confidence gained. If water merely is to be injected, let them be informed, but do not commit the professional error (not to speak of moral wrong) of being concerned and caught in an attempt to deceive.

I have had excellent results from the injection of water into paralyzed and wasting muscles: it promotes their nutrition, and contributes indirectly to the regeneration of voluntary power.

* Lafitte, Union Médicale, No. 113, 1875.

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## XXIII.

### IRRITANT INJECTIONS.

Dr. Luton,* of Rheims, under the singular designation "parenchymatous substitution," described a method of treating neuralgias, new formations, hypertrophies, etc. This method consists in the injection into the substance of the affected part of such irritants as tincture of iodine, nitrate of silver, chloride of sodium, etc. The term applied to this process was intended to express the theoretical views of its author in regard to the nature of the therapeutical action which takes place. The pain and irritation set up in the part were assumed to be *substituted* for the morbid process.

Dr. Ruppaner imitated this method of Luton in the treatment of sciatica and other neuralgias. Dr. Bertin (de Gray) also, attracted by the results obtained by Luton, practised the method for several years and then published the results.† I have had myself a limited experience with this method.

The substances employed in this way are chiefly the following:

A solution of iodine.

A saturated solution of common salt.

A solution of the nitrate of silver.

The tincture of cantharides.

---

* Archives Générales de Médecine, Oct. et Nov. 1863.

† Ibid., Avril, 1868, p. 444.

The following is the solution of iodine employed by Bertin:

℞.—Potassii iodidi, gr. xv;
Tinct. iodinii. ʒijss;
Aquæ destil., ʒx. M.

The quantity of tincture of iodine may be increased to ʒv.

The tincture of iodine is sometimes employed alone and undiluted.

The following is a suitable formula for the nitrate of silver solution:

℞.—Argenti nitrat., ʒj;
Aquæ destil., ʒj. M.

To illustrate at the same time the class of cases to which this method is applicable, and its therapeutic power, I subjoin the statistics of Dr. [illegible]:

1. Tumors formed by development [illegible]
   Cured [illegible]
   Ameliorated [illegible]
   Failed [illegible]
2. Lymphatic ganglions [illegible]
   Cured [illegible]
3. Bursæ [illegible]
   Cured [illegible]
4. Neuralgias [illegible]
   Old sciatica treated [illegible]
   Cured [illegible]
   Old sciatica treated [illegible]
   Cured [illegible]
   Recent sciatica treated [illegible]
   Ameliorated [illegible]
   Recent sciatica treated [illegible]
   silver [illegible]
   Cured [illegible]

Ruppaner employed the nitrate of silver injection in one case of cervico-brachial neuralgia, and in four cases of sciatica; two cases were ameliorated, and three cases of sciatica were cured.

As respects *neuralgia*, this method of treatment seems specially adapted to cases of sciatica,—obstinate cases in which structural alterations have probably taken place in the neurilemma. In order to be effectual, the injection—five drops of the nitrate of silver solution—should be thrown into the vicinity of the nerve. It produces great pain and burning, and is followed by considerable inflammation, not diffused, but localized to the site of the injection. Abscesses, of course, frequently happen from this practice, and, indeed, sufficient irritation to result in this way seems necessary to produce the best effects. It is probably true that the irritation, and not the agent, is the principal factor in the curative process.

Injections of the iodine solution have been practised with success in *goitre*. The tincture of iodine may be thrown into the substance of an enlarged thyroid without producing violent irritation. Five minims of the tincture will be sufficient for this purpose, and it may be repeated every other day. Recent cases are quickly cured by this treatment. I have seen excellent results from the same application in those *cystic and glandular tumors* so frequently found in the cervical region. After evacuating the cyst with a trocar, the tincture of iodine may be

freely thrown into the sac, and the solid parts of the tumor injected by the hypodermic syringe, the needle point being well introduced into the substance of the growth.

*Enlarged bursæ* are best treated by the same means: evacuate the contents and inject the solution of iodine. Slight inflammatory action follows, the tumor becomes indurated, and finally disappears.

Solid tumors may be destroyed by injecting such irritants into them as will give rise to violent inflammatory action and sloughing. Into the substance of cancerous new formations various corrosives may be injected; but this practice, although rational, has not hitherto proved satisfactory,—a remark equally true of Dr. Broadbent's method of injecting dilute acetic acid,—of the success of which such confident expectations were at first entertained.

Recently* considerable success has been claimed for the treatment of tumors by the injection into their intimate structure of *gastric juice*. As this practice is devoid of danger in suitable cases, and as the gastric juice is not difficult to obtain from the stomach of the pig, it is desirable to have further experience in order to form decided opinions as to its utility.

It would be foreign to my purpose to speak of such uses of the iodine solution as the injection in hydrocele, in hydrothorax and empyema, in cystic disease of the ovary, etc., and of the use of perchloride and persulphate of iron in nævus.

* Bulletin Général de Thérapeutique, Août 15, 1869.

INJECTION OF AMMONIA INTO THE VEINS.—As the hypodermic syringe is the instrument employed in this operation, it may be proper to include in my account of hypodermic medication some references to the injection of ammonia into the veins. We owe to Prof. Halfourd, of Melbourne, Australia, the introduction of this important means of relief. He used it to overcome and remove the lethal effects of the poison of venomous snakes. A number of successful cases have now been reported occurring in the practice of Prof. Halfourd and others. The solution used consists of one part of *aqua ammoniæ fortior* and two parts of distilled water. By means of an ordinary hypodermic syringe this solution is injected into a vein. The quantity is determined by the effect; one or more syringefuls may be injected. Care must be used to prevent the introduction of air. The operation appears to be devoid of danger, and to be free from ulterior bad effects.

The injection of ammonia is indicated not only in the case of poisoning by venomous snakes, but in various conditions in which the danger to life consists in depression of the heart's action. In *poisoning by hydrocyanic acid* it may be used with a good prospect of success. The report of a case of poisoning by chlorodyne has lately come to us from Australia, in which life was saved by the injection of ammonia. In cases of danger from thrombus of an important vessel, as, for example, thrombus of the pulmonary artery, a cause of sudden death after de-

livery, this mode of treatment is strongly indicated. In failure of the heart's action during chloroform narcosis, the injection of ammonia should be promptly practised.

Recent experiences by Brunton and Fayrer have demonstrated that the intravenous injection of ammonia is not effective against the poisoning by the venomous snakes of India, and grave doubts are now entertained in respect to the same practice in the poisoning by Australian snakes, the apparent cures heretofore reported being instances of the *post* rather than the *propter hoc*.

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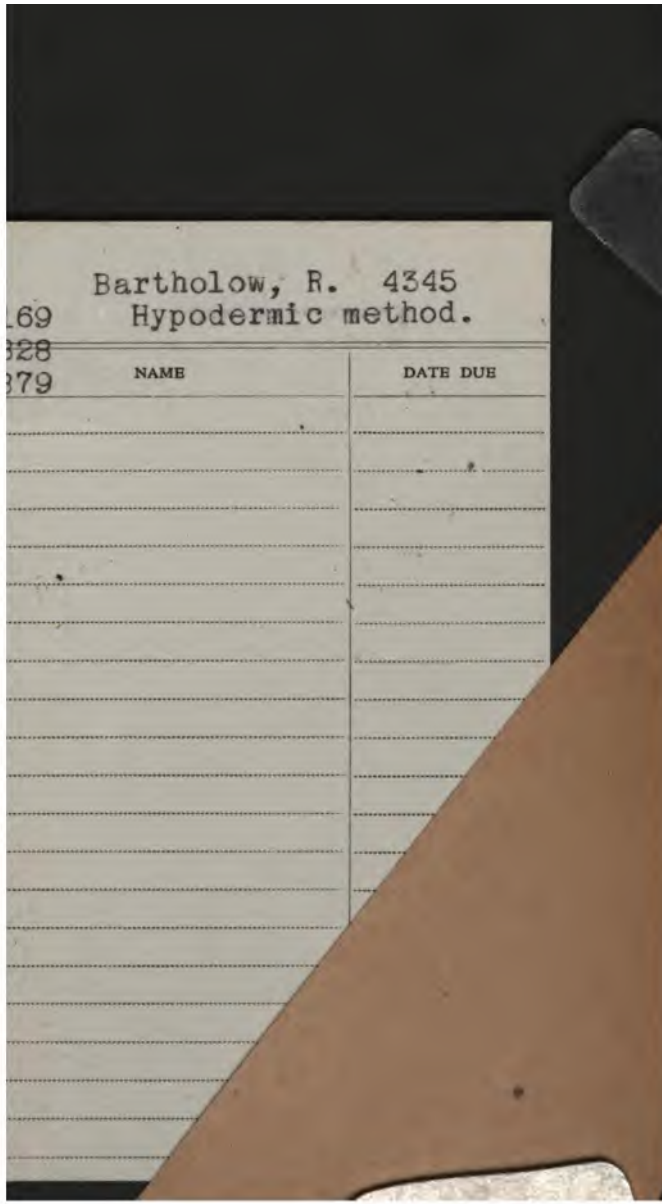
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